

# Basic Functional Anatomy of the Gnathostomatic System and its Clinical Implications

Eugene Santucci DDS, MA, FACD

NOTHING IS MORE  
FUNDAMENTAL TO  
TREATING PATIENTS THAN  
KNOWING ANATOMY

Jeffery P. Okeson

# Topics to be Discussed

Revisit the anatomy of the GSS, more in a sense of clinical importance to the study of sleep medicine

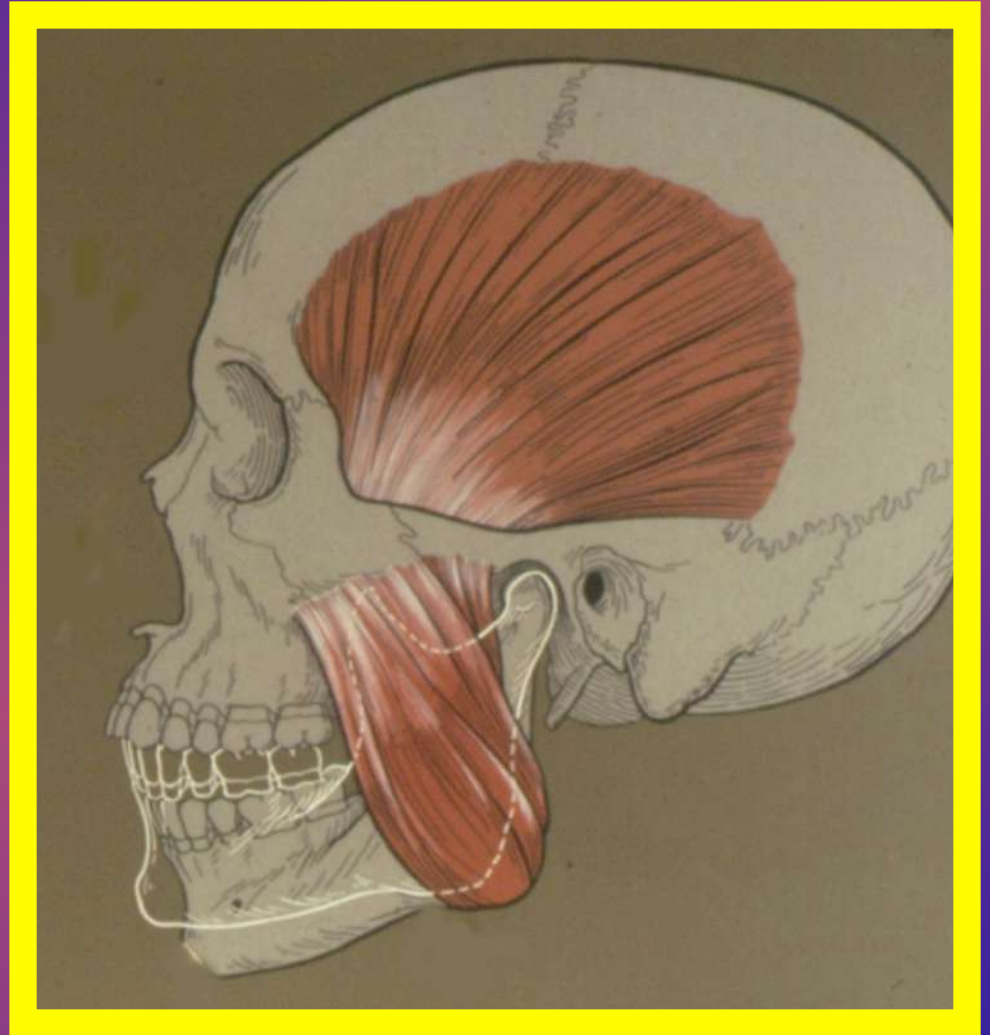
Functional anatomy of the TMJ

Functional anatomy of muscles of mastication

Review internal oral structures

Review of the nose, the carburetor of the body  
it's anatomy and function

# Muscles Of Mastication



Eugene T. Santucci, D.D.S., M.A. FACD.

# Muscles

- \* Play a key role in masticatory functions, speaking and swallowing
- \* May exhibit differential regional action due to complex movements of the TMJs
- \* "Muscle" really is not just a contracting entity

# Actions of Muscles

Functional;

speaking

swallowing

mastication

Parafunctional:

bruxing

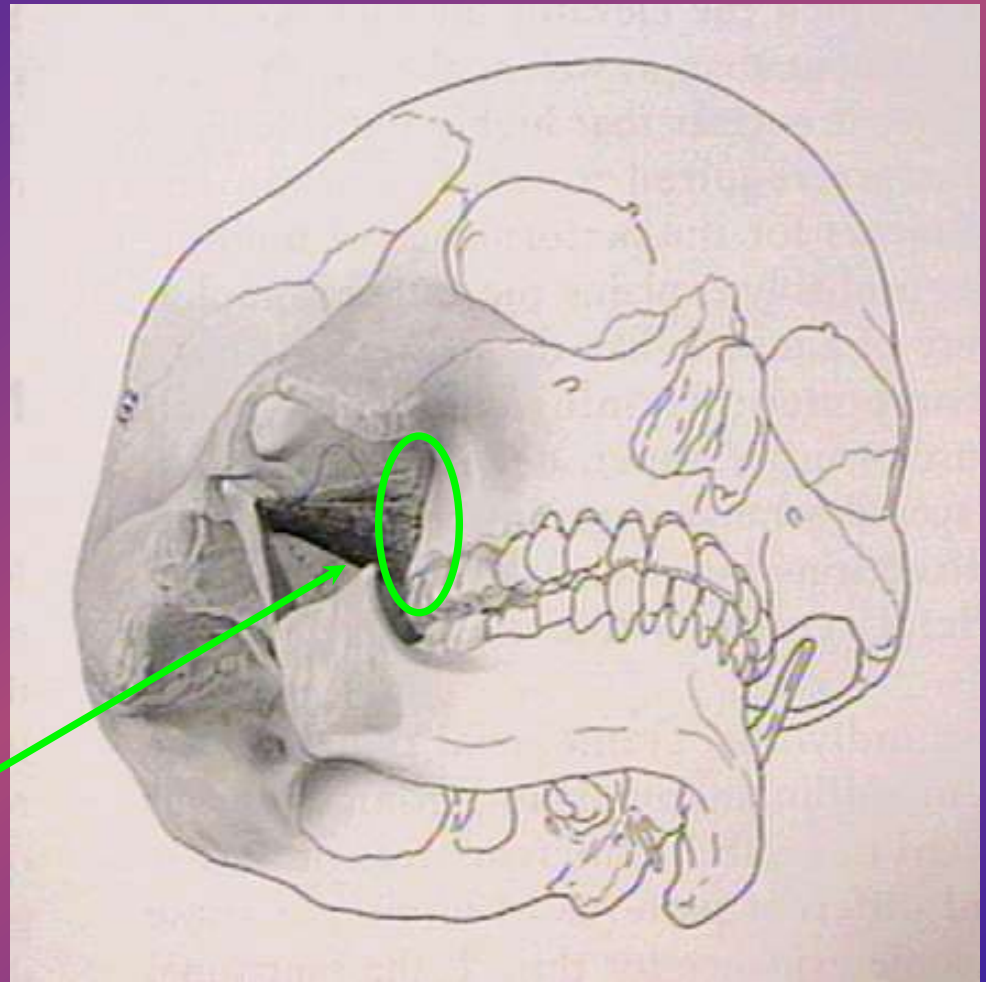
clenching

# Lateral Pterygoid Muscle

Has two origins:

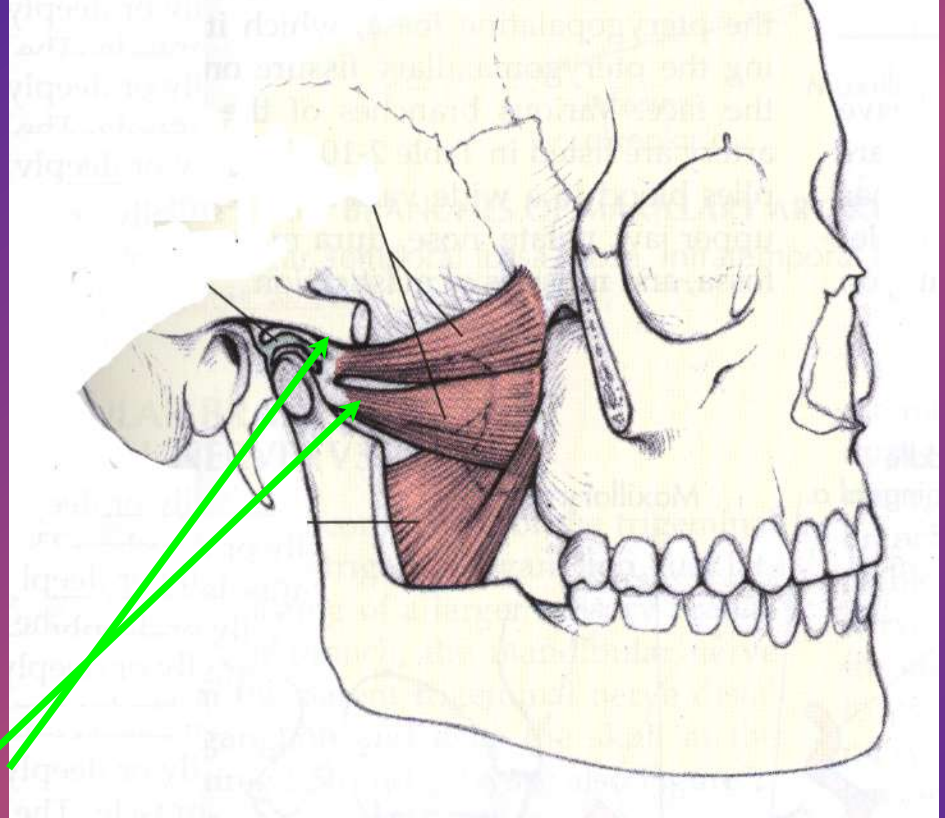
one head originates on the outer surface of the lateral pterygoid plate

an upper or superior head originates on the greater sphenoid wing





# Lateral Pterygoid Muscle



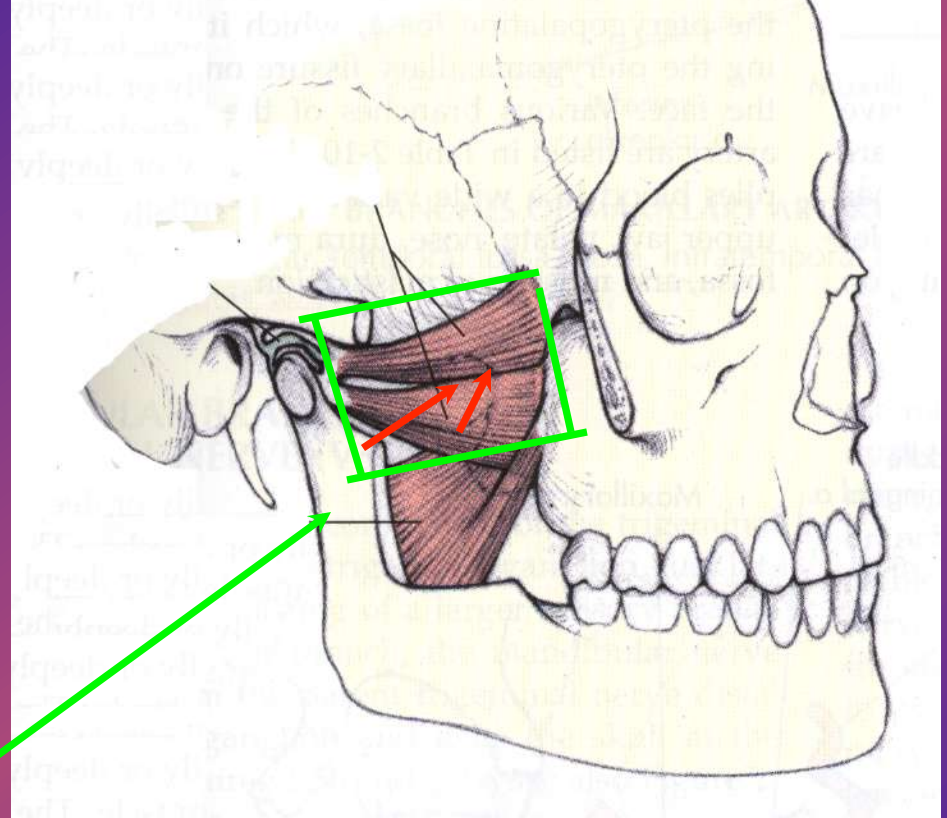
Has two insertions:

The inferior head inserts on the anterior surface of the neck of the condyle

the superior head inserts some fibers to the capsule of the joint and to the anterior aspect of the articular disc



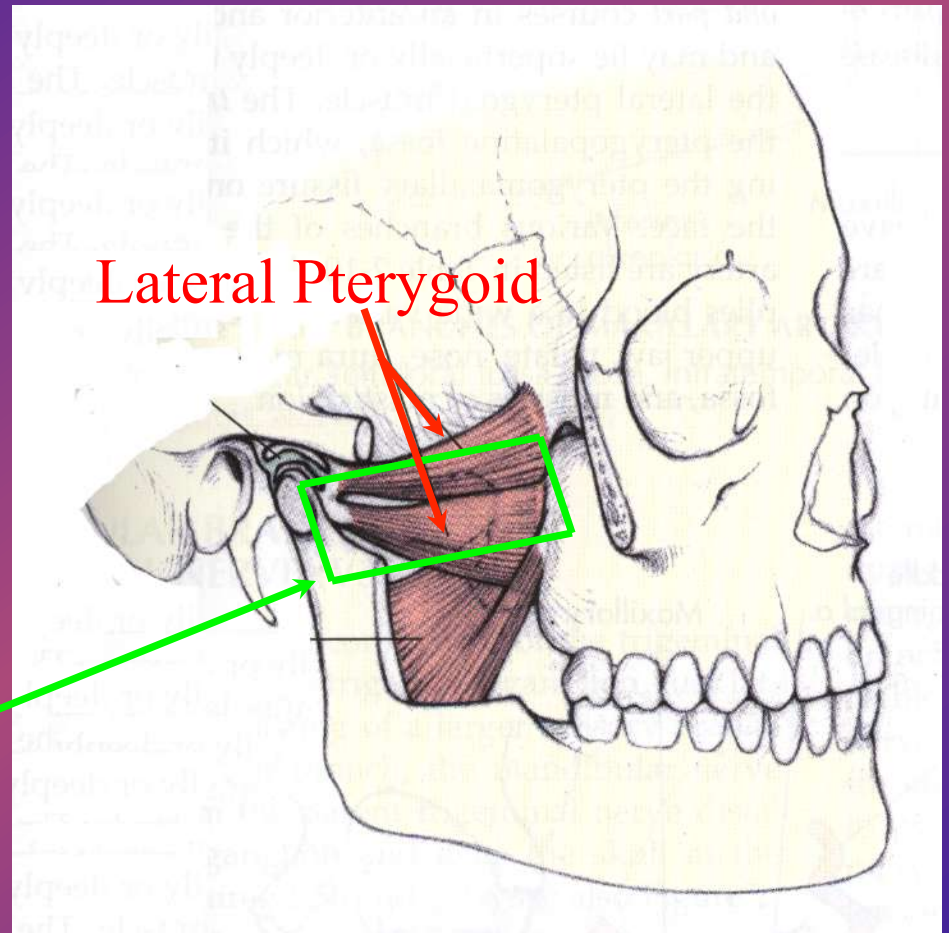
# Lateral Pterygoid Muscle



- \* Superior head active during jaw closing movements. Positions the disc at final closure

Example: chewing, clenching and swallowing

# Lateral Pterygoid Muscle

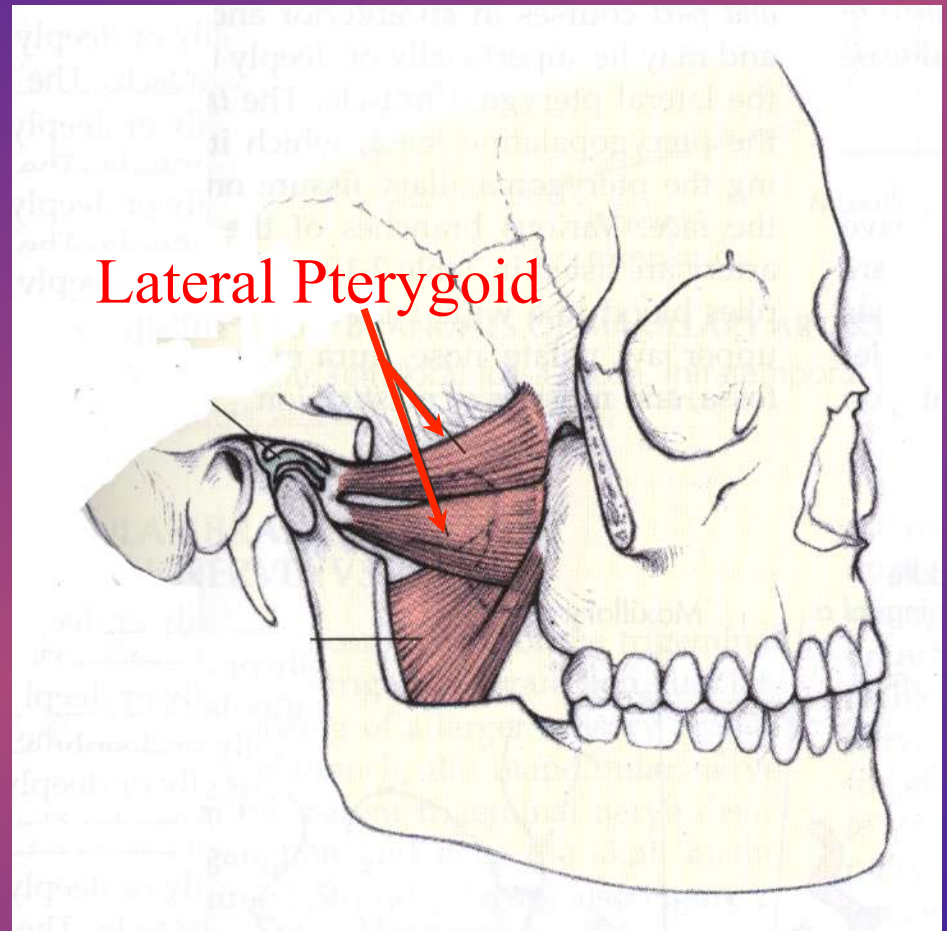


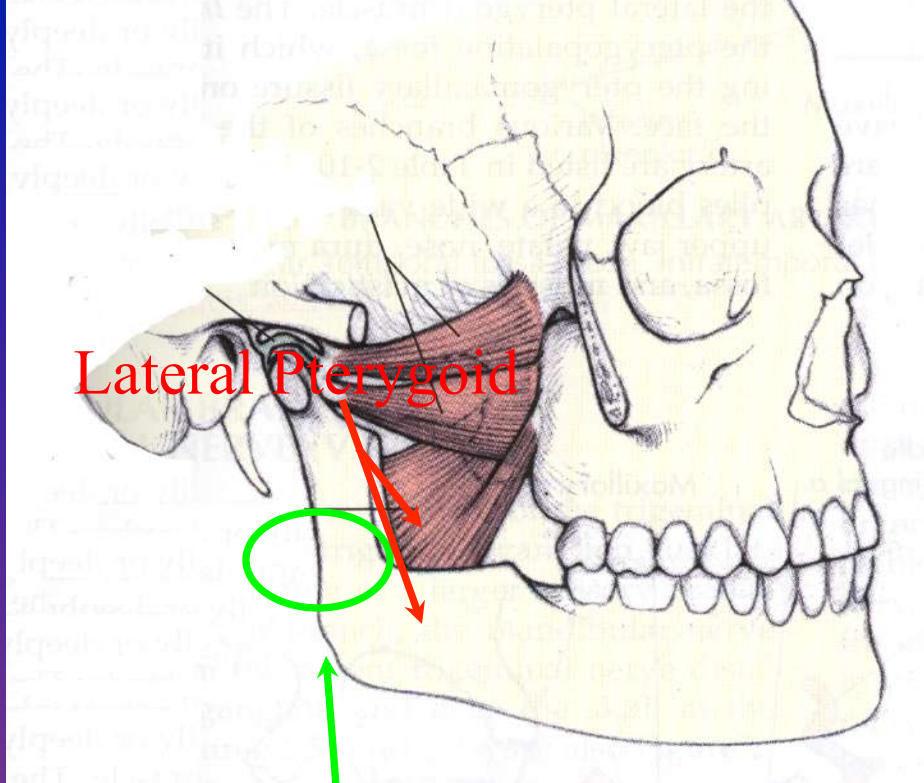
- Inferior head active during jaw opening movements and protrusion
- Retro-orbital pain
- Deviation to contralateral side

# Lateral Pterygoid Muscle

Suited for:

- 1) Protraction
- 2) Depression
- 3) Contralateral Abduction
- 4) May be active during other movements for joint stabilization





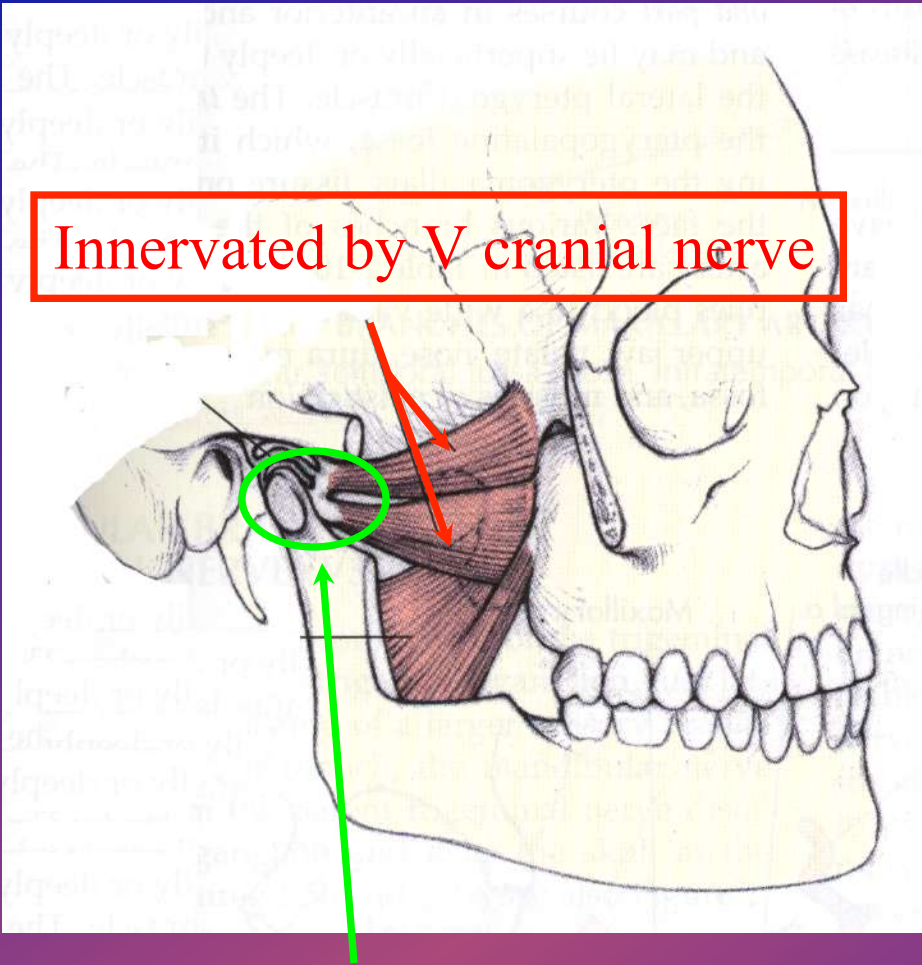
# Lateral Pterygoid Muscle

Superior head positions or stabilizes the condylar head and disc against the articular eminence during mandibular closing

80% of the muscle is composed of slow movement fibers, resistant to fatigue



Innervated by V cranial nerve

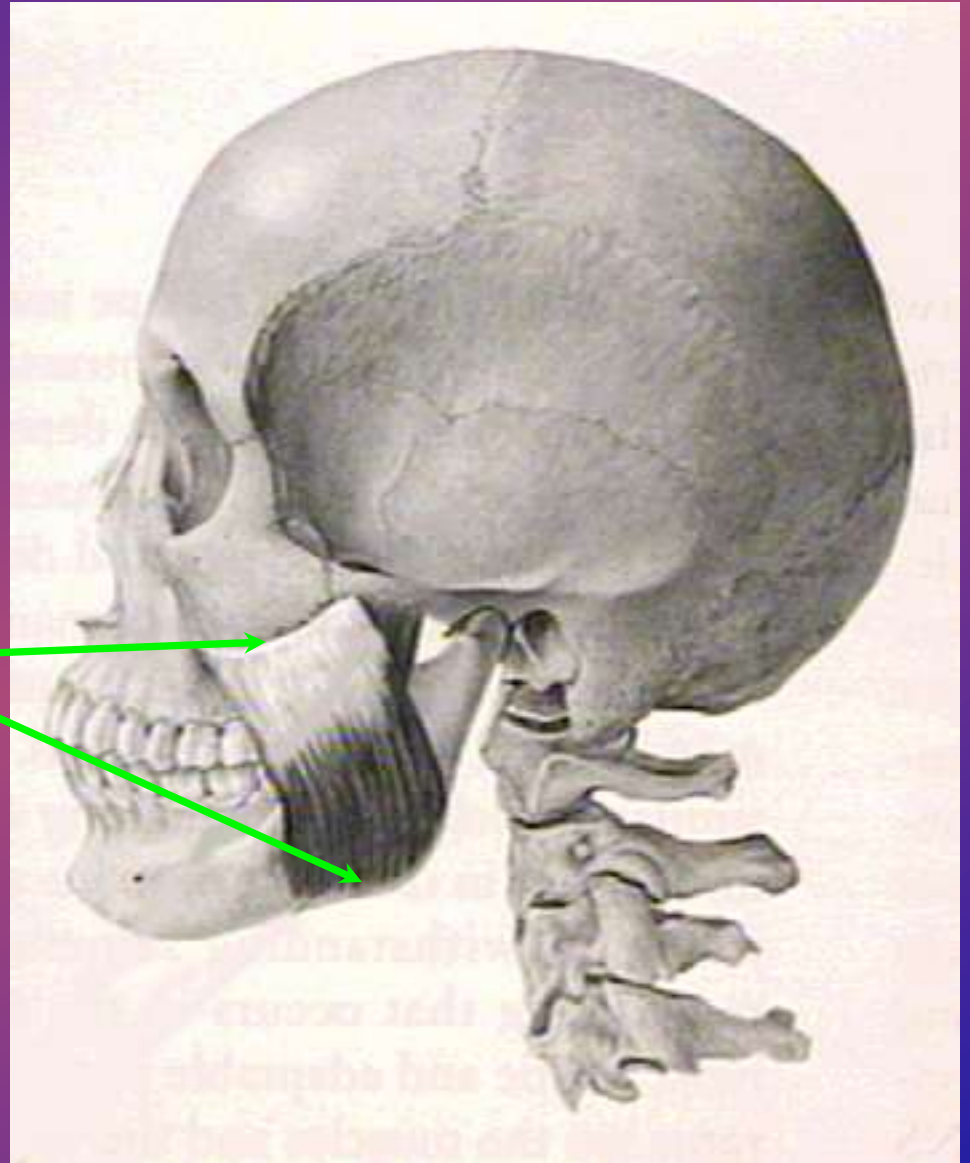


## Lateral Pterygoid Muscle

- \* Inferior head assists in the translation of the condyle downward, anteriorly, and contralaterally during opening

# Masseter Muscle

- \* Extends from the zygomatic arch to the ramus of the mandible.

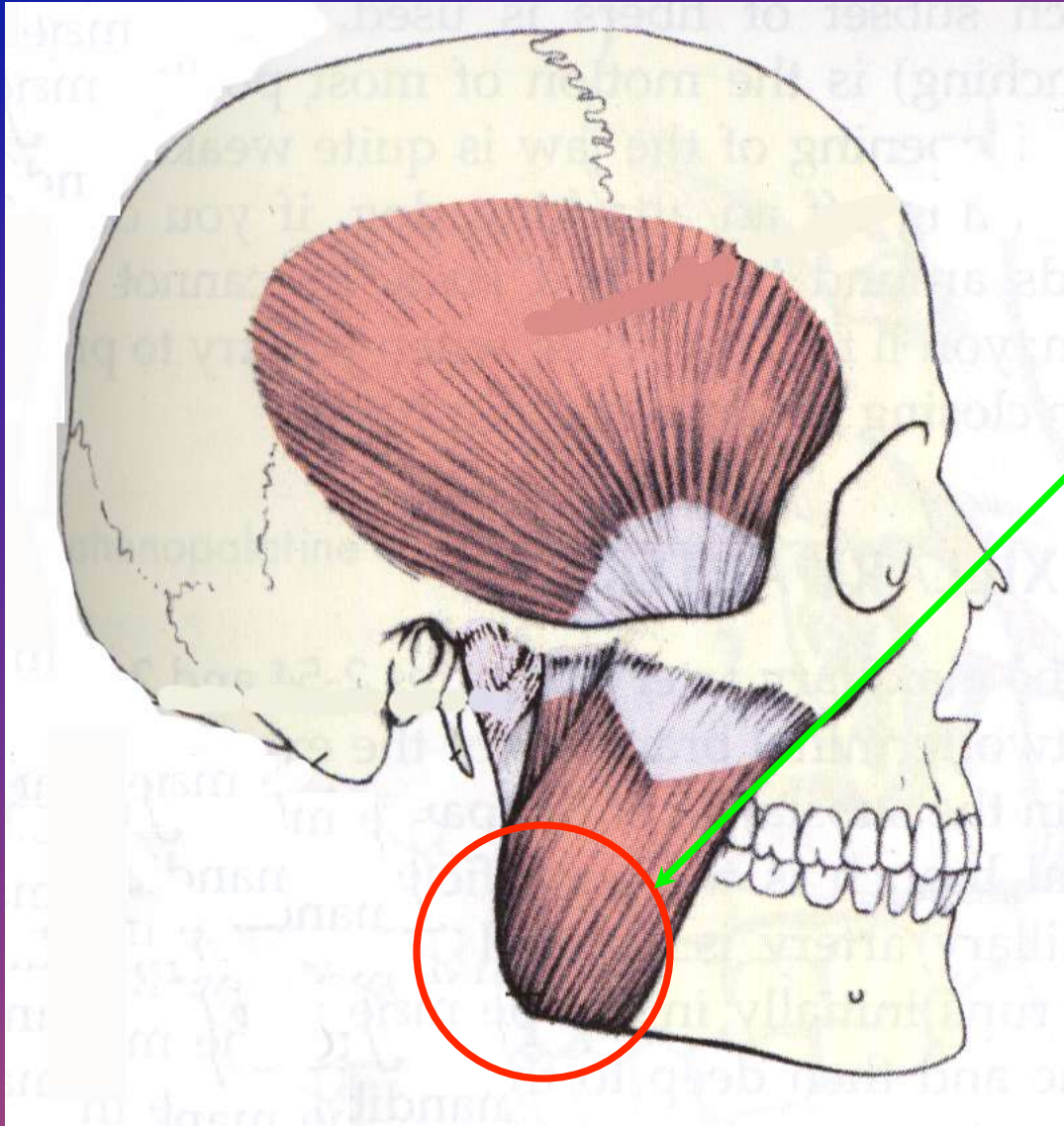


# Masseter Muscle

\* Insertion of the muscle is broad, extending from the second molar to the posterior lateral surface of the ramus

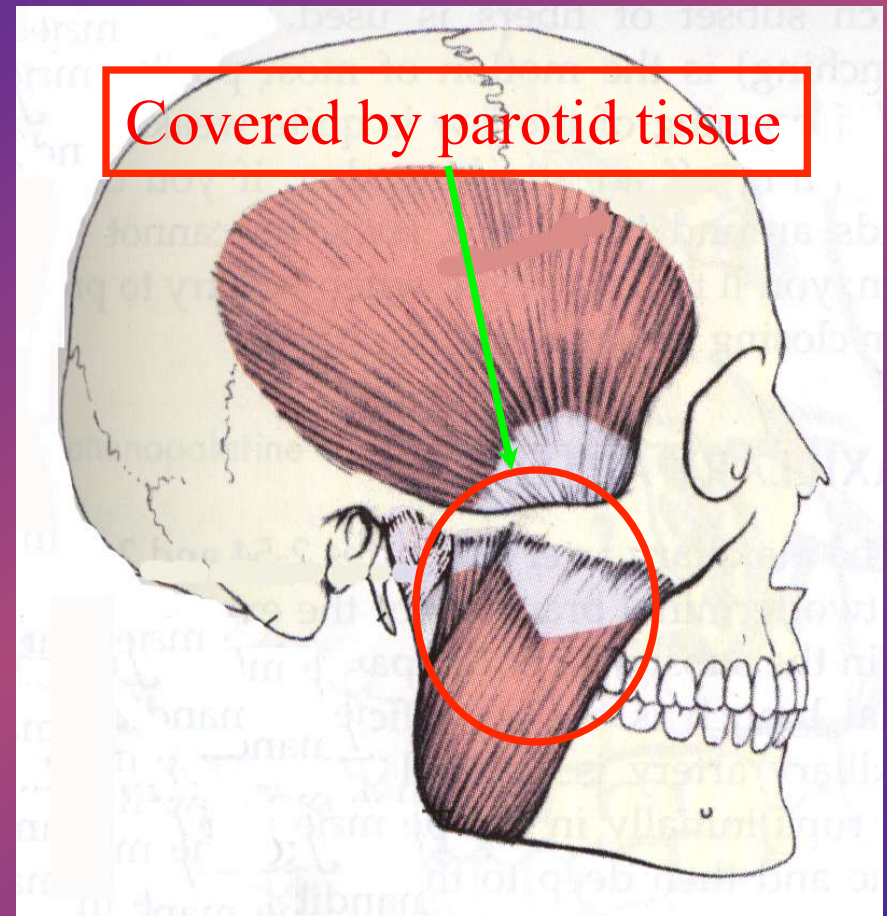
\* Muscle hypertrophy

\* Glenoid notch





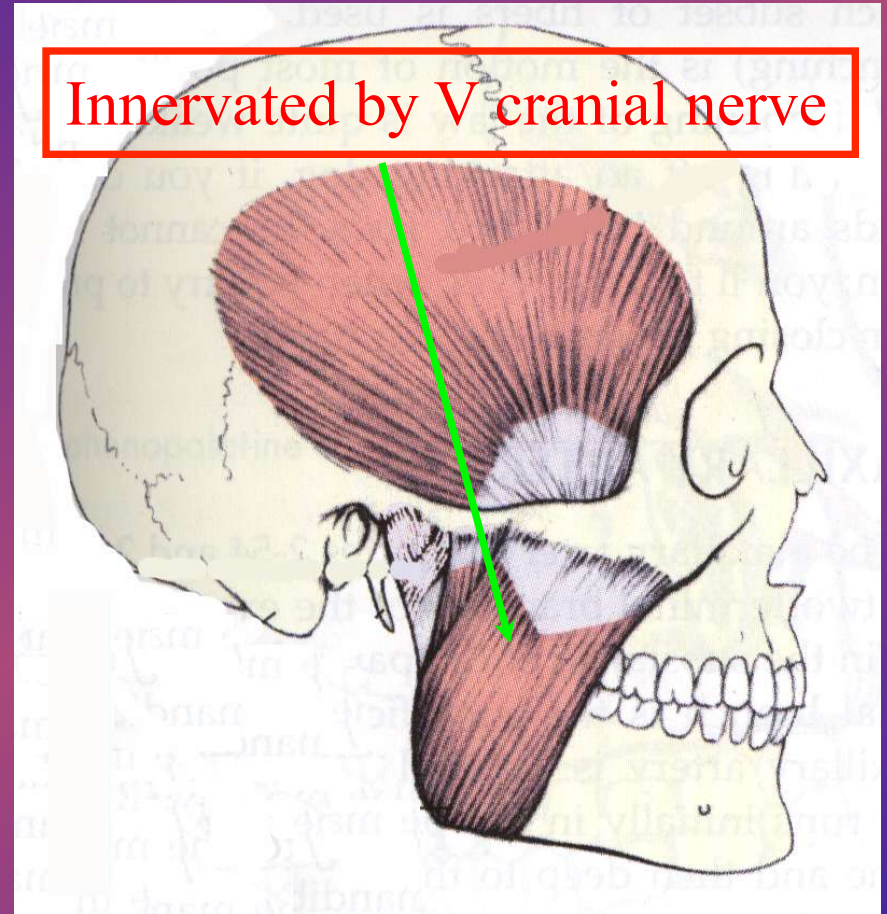
# Masseter Muscle



- \* The superficial part of the muscle is separated only from the deeper layer at the posterior upper portion

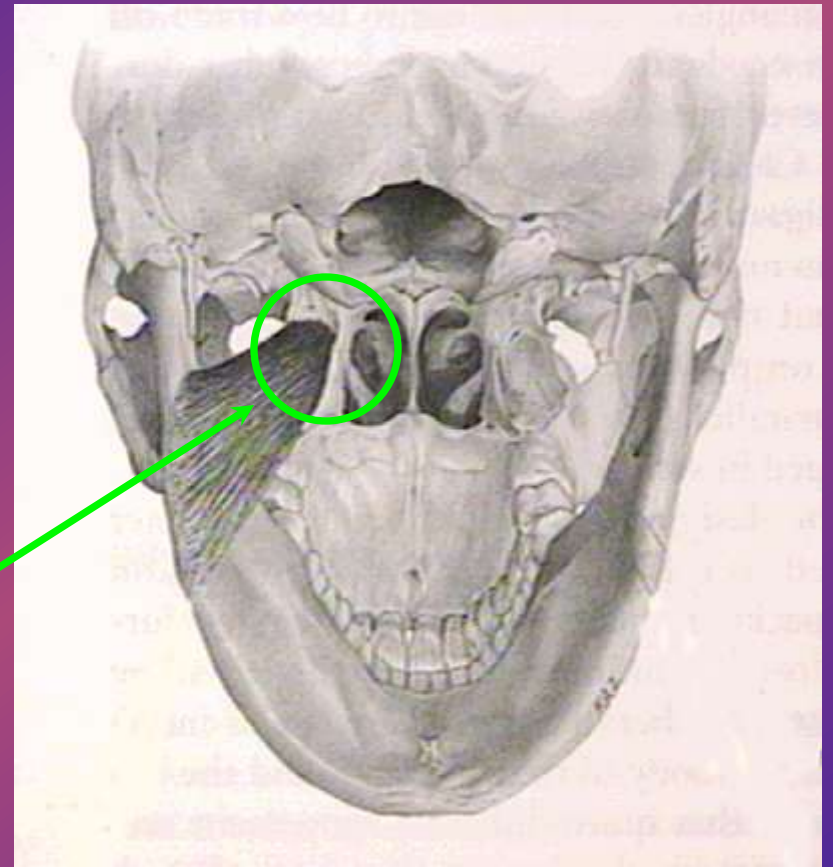
# Masseter Muscle

Innervated by V cranial nerve



- Active during forceful jaw closing and may assist protrusion. 250 lbs/sqin
- Deviation to the affected side

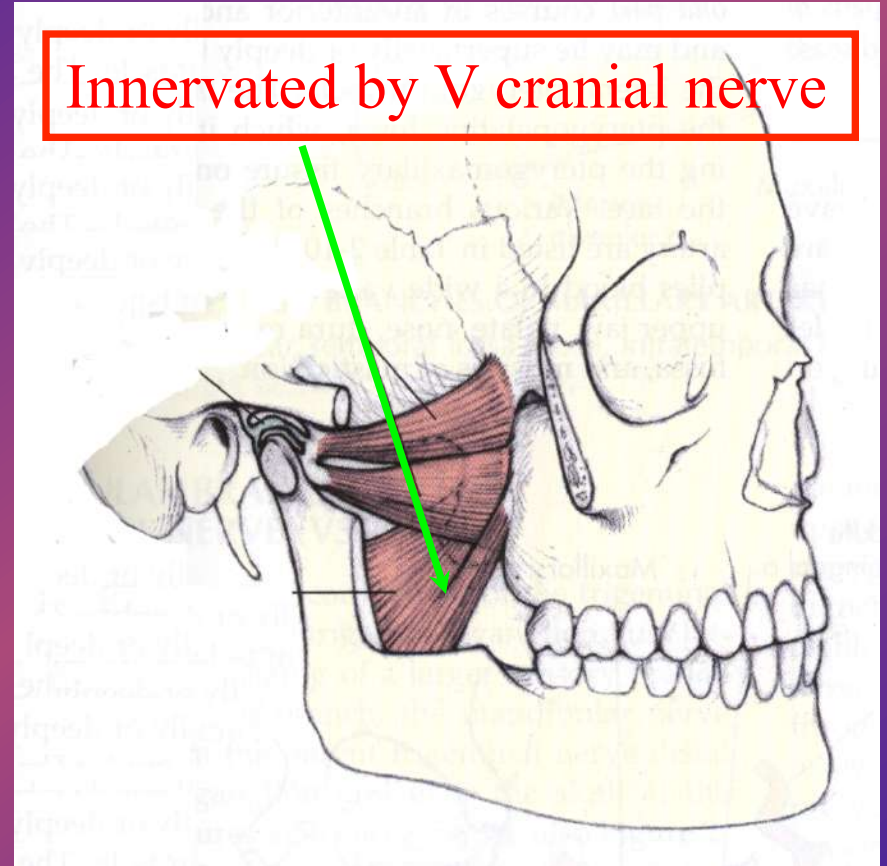
# Medial Pterygoid Muscle



- \* Arises from the medial surface of the lateral pterygoid plate and from the palatine bone

# Medial Pterygoid Muscle

Innervated by V cranial nerve

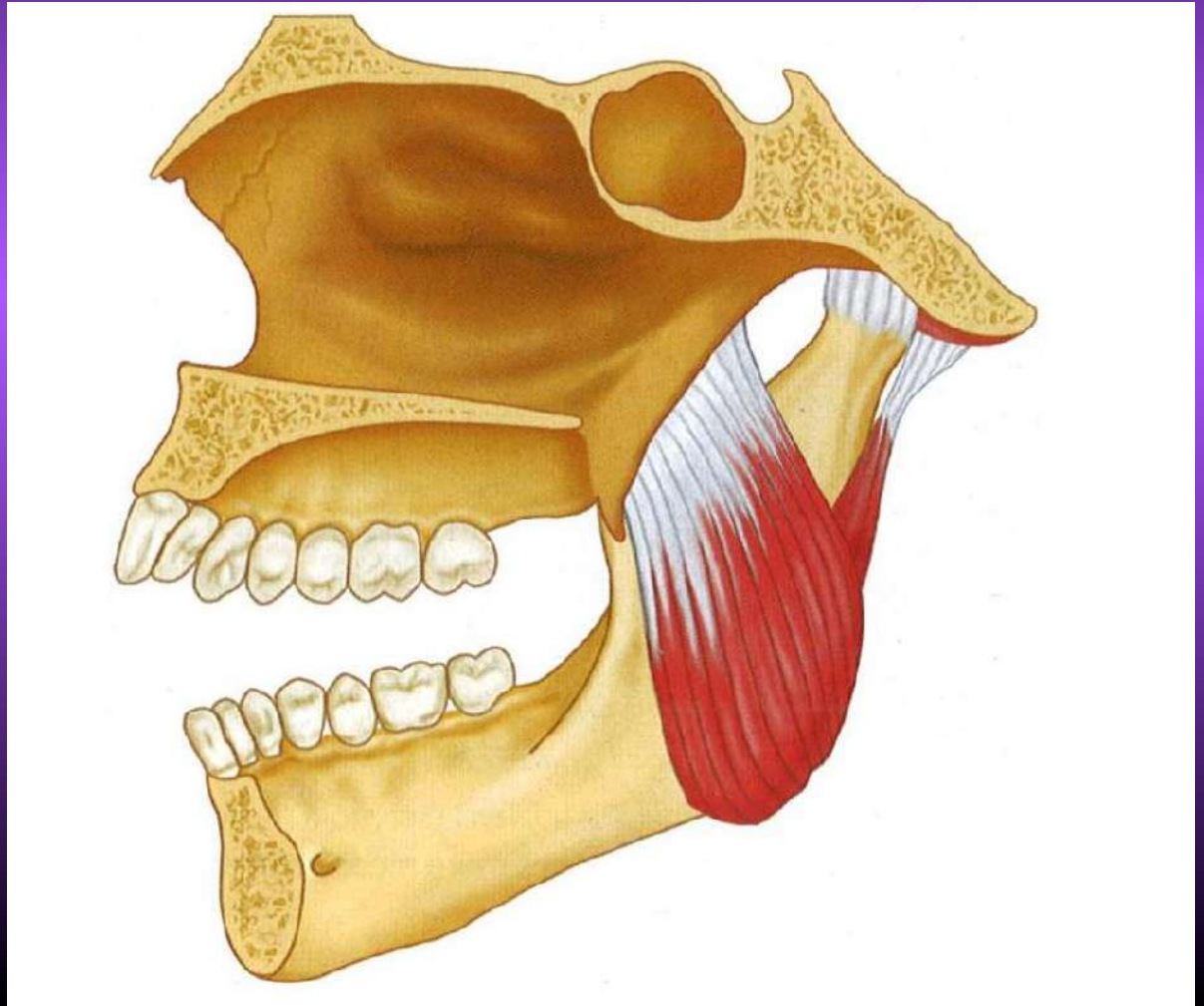


- \* It functions in elevation and lateral positioning of the mandible
- \* It is active during protrusion

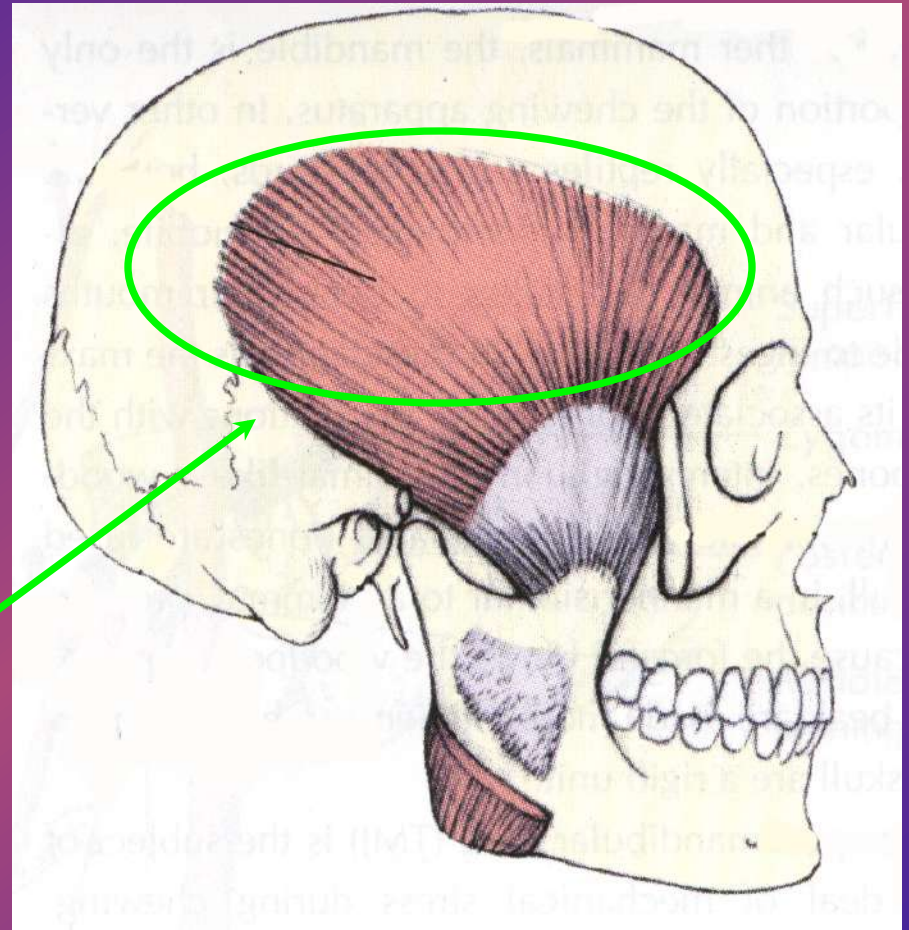


# Medial Pterygoid Muscle

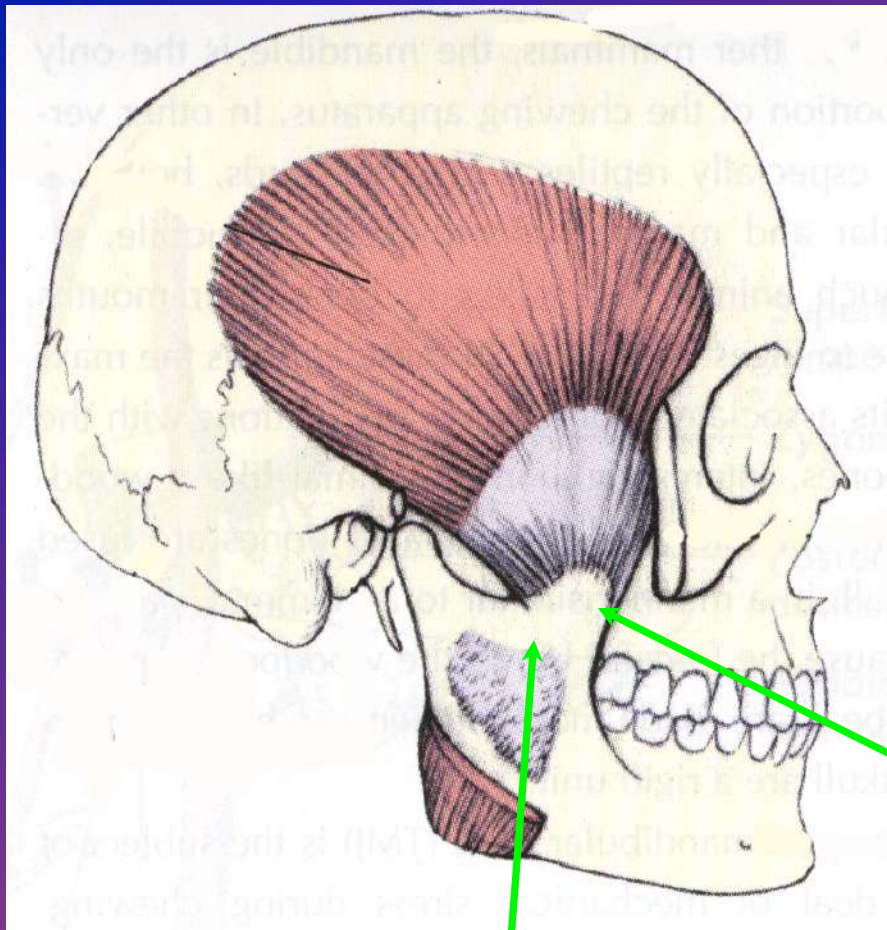
Injection  
Trauma



# Temporalis Muscle



- The temporalis muscle is fan-shaped and originates in the temporal fossa
- Muscle contraction head aches



# Temporalis Muscle

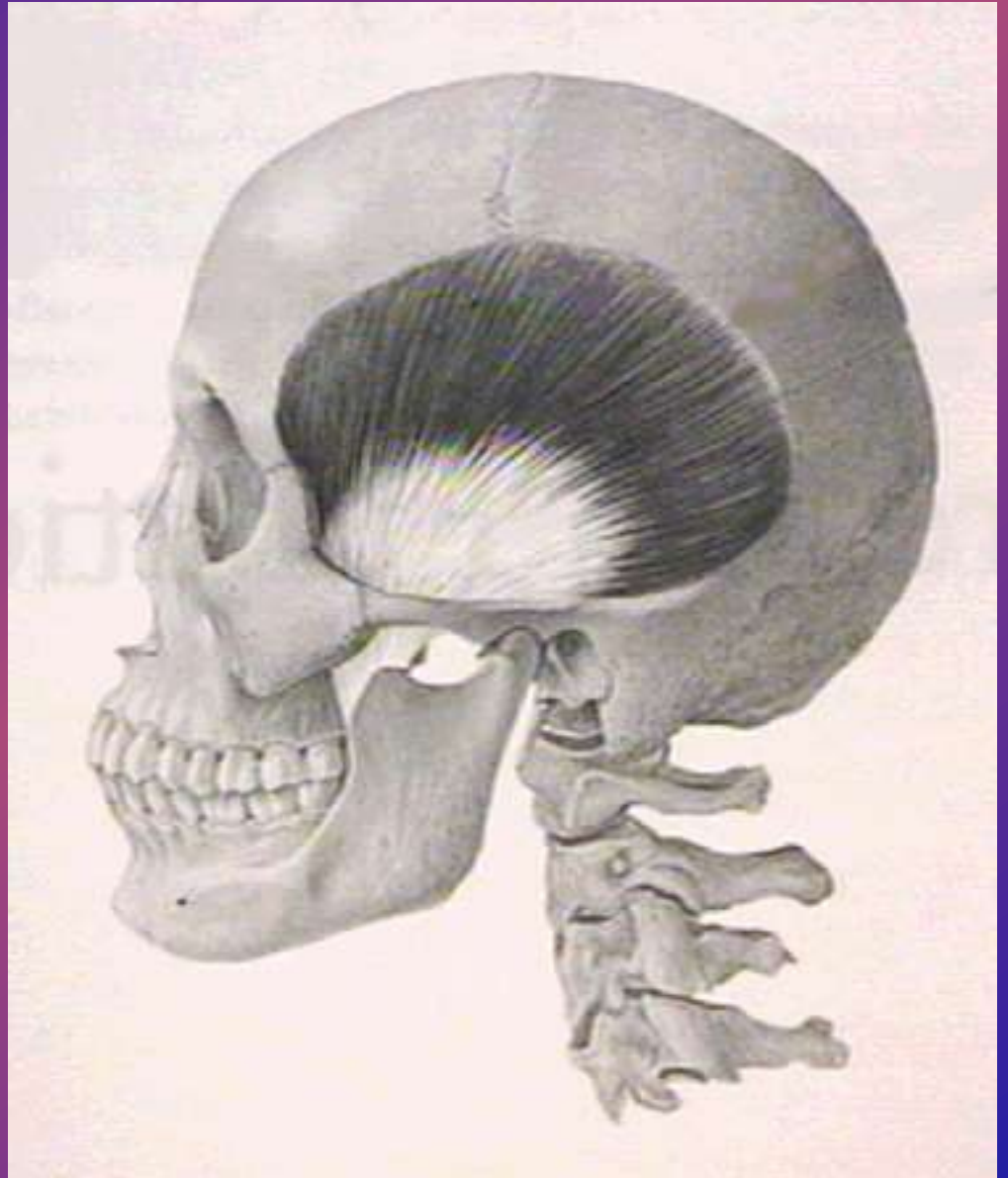
\* On passing to the zygomatic arch it forms a tendon that inserts into the

anterior border and the mesial surface of the coronoid process of the mandible and the anterior border of the ramus

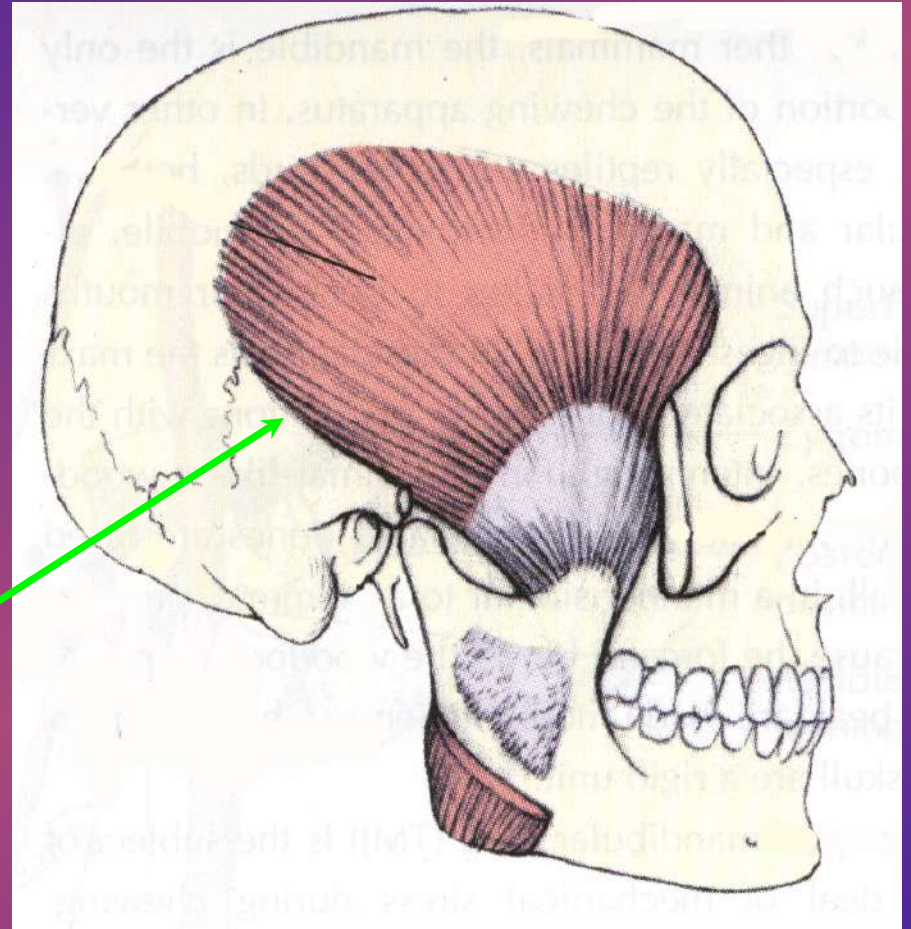


# Temporalis Muscle

- \* The muscle appears to have three component parts and appears to behave that way



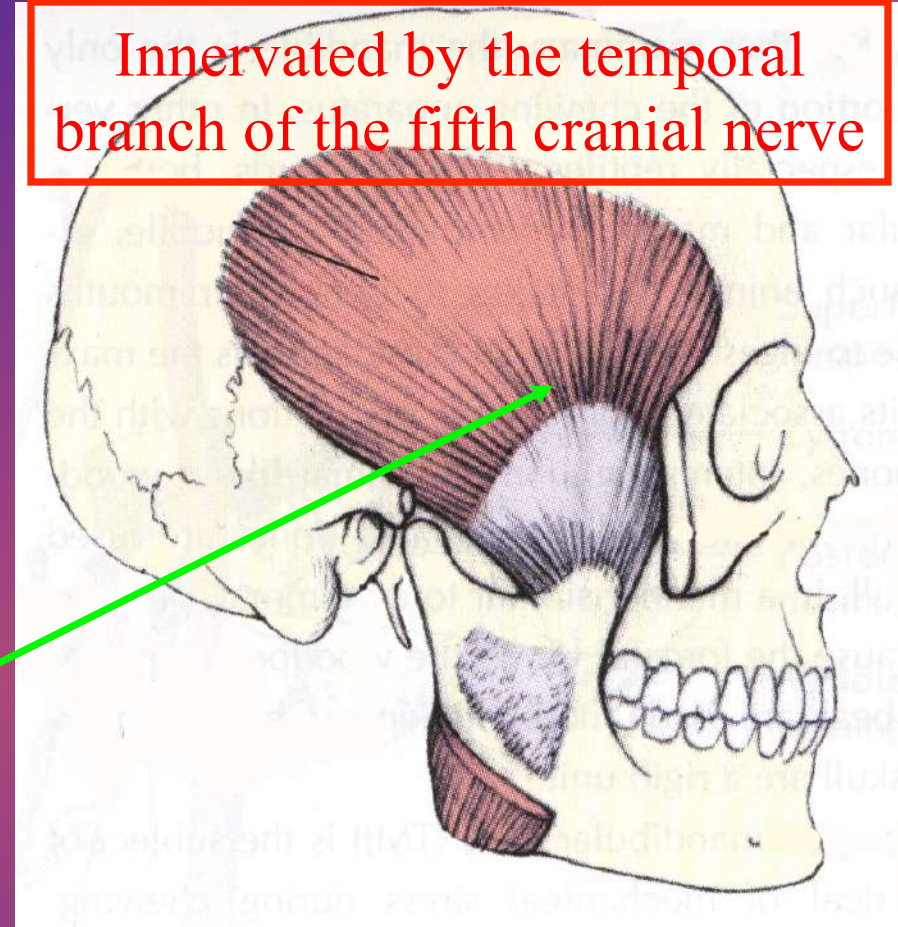
# Temporalis Muscle



- The posterior part is active in retruding the mandible - may act as a antagonist to the masseter
- Scalp and hair tenderness

# Temporalis Muscle

Innervated by the temporal  
branch of the fifth cranial nerve



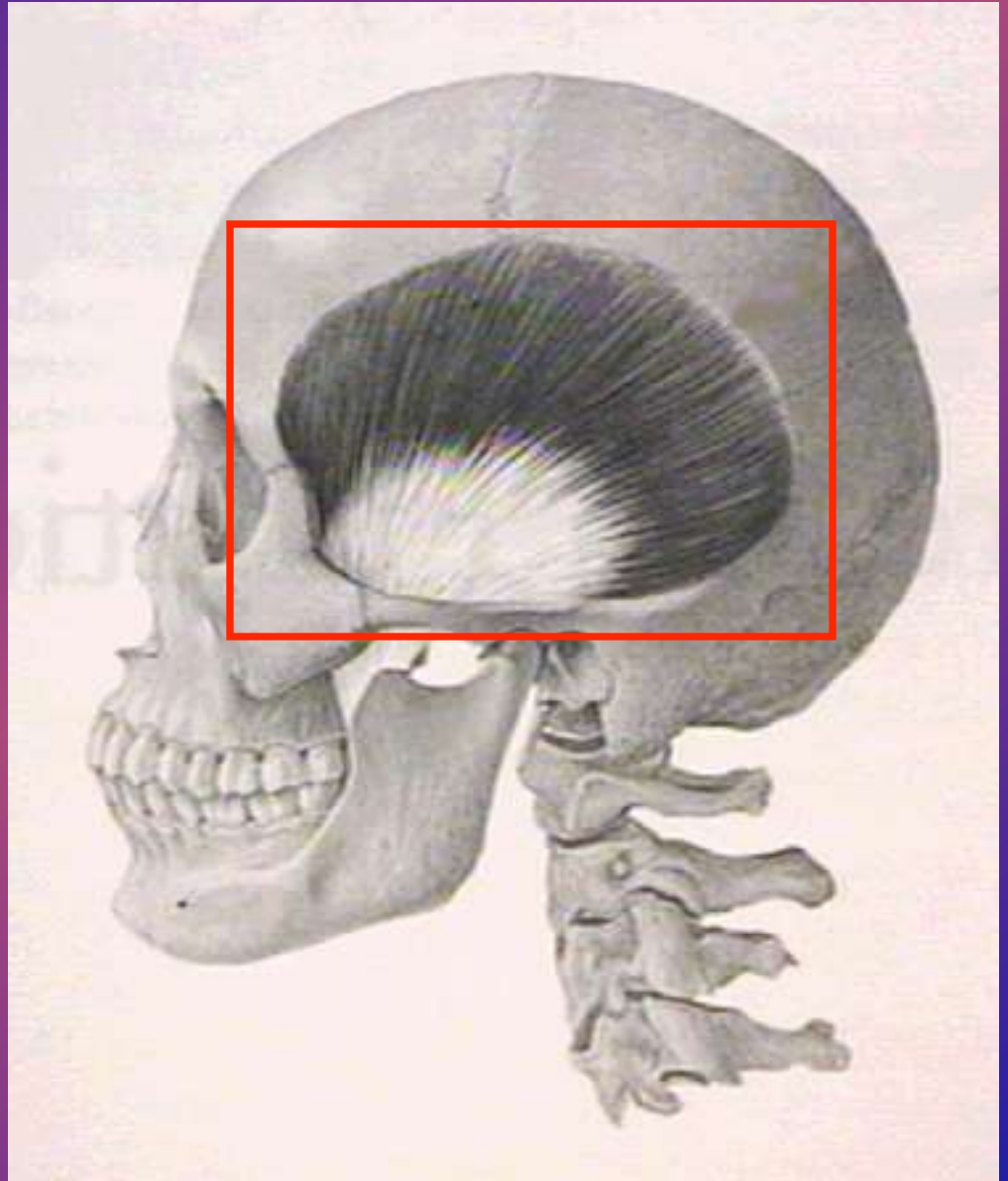
- The anterior part is active in clenching - may act as a synergist with the masseter
- Muscle contraction headache
  - Rule out Migraine , Face plant



# Temporalis Muscle

- \* The temporalis muscle is the principle positioner of the mandible during elevation

- \* Muscular seating sequence

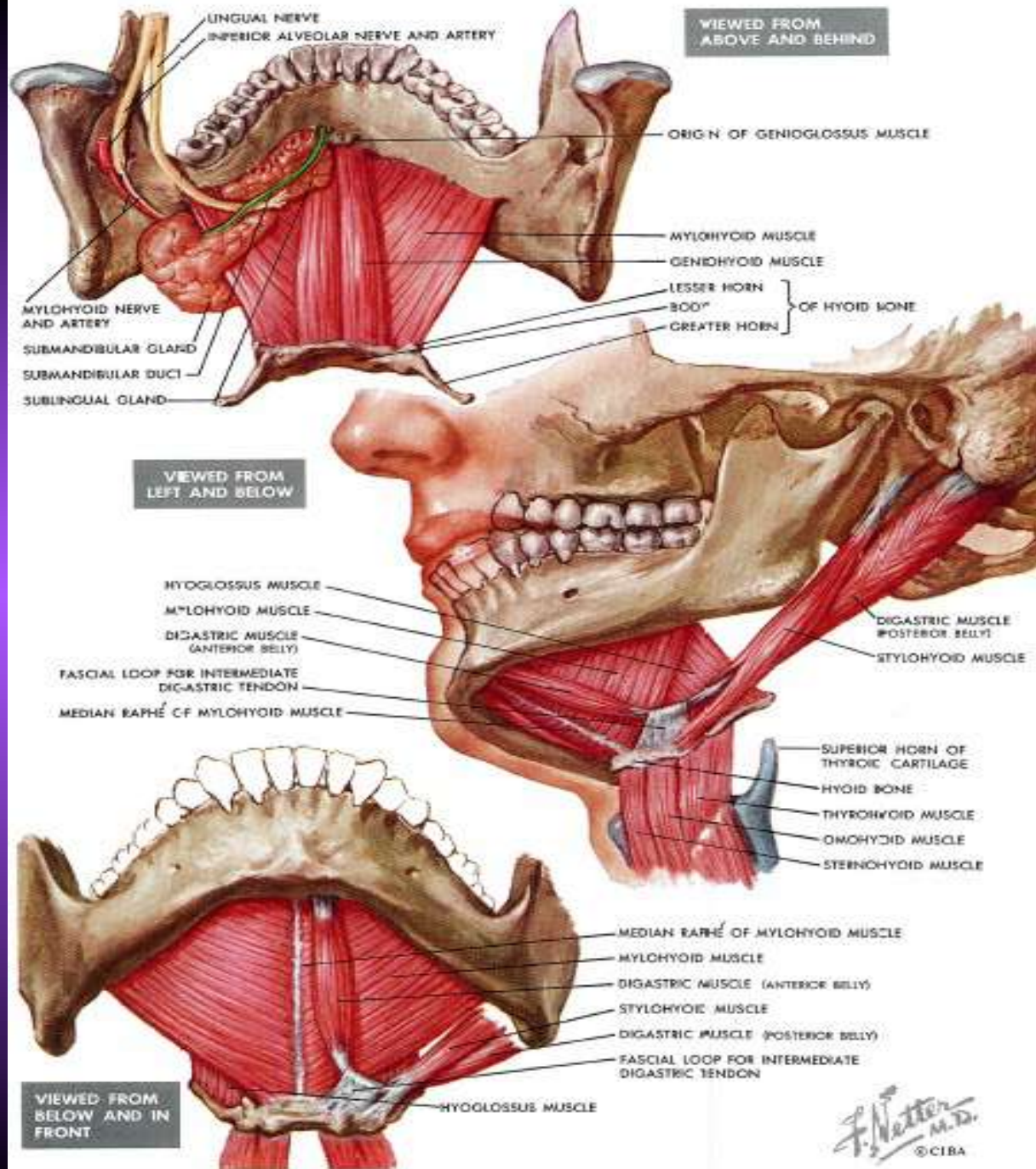


# Digastric Muscle

- \* Attachment of the anterior digastric is at or near the lower border of the mandible and near the midline
- \* There is a tendon between the anterior and posterior portion attached to the hyoid bone by a looplike tendon.

# Digastric Muscle

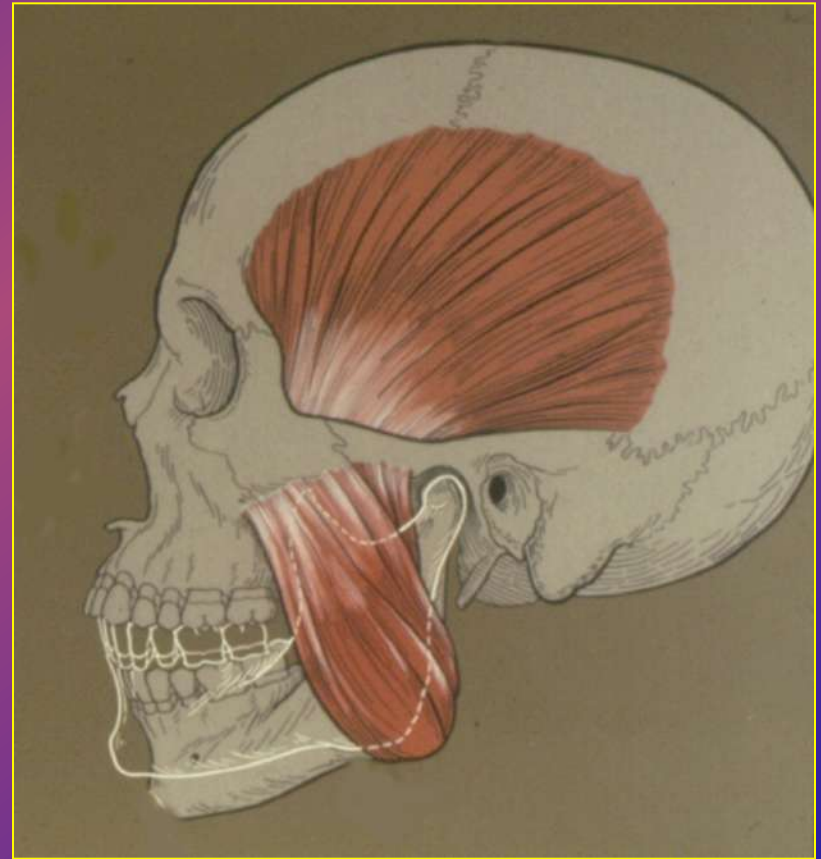
- \* Anterior part is covered by the platysma muscle, and beneath lie the mylohyoid and geniohyoid muscles - all are active during jaw opening

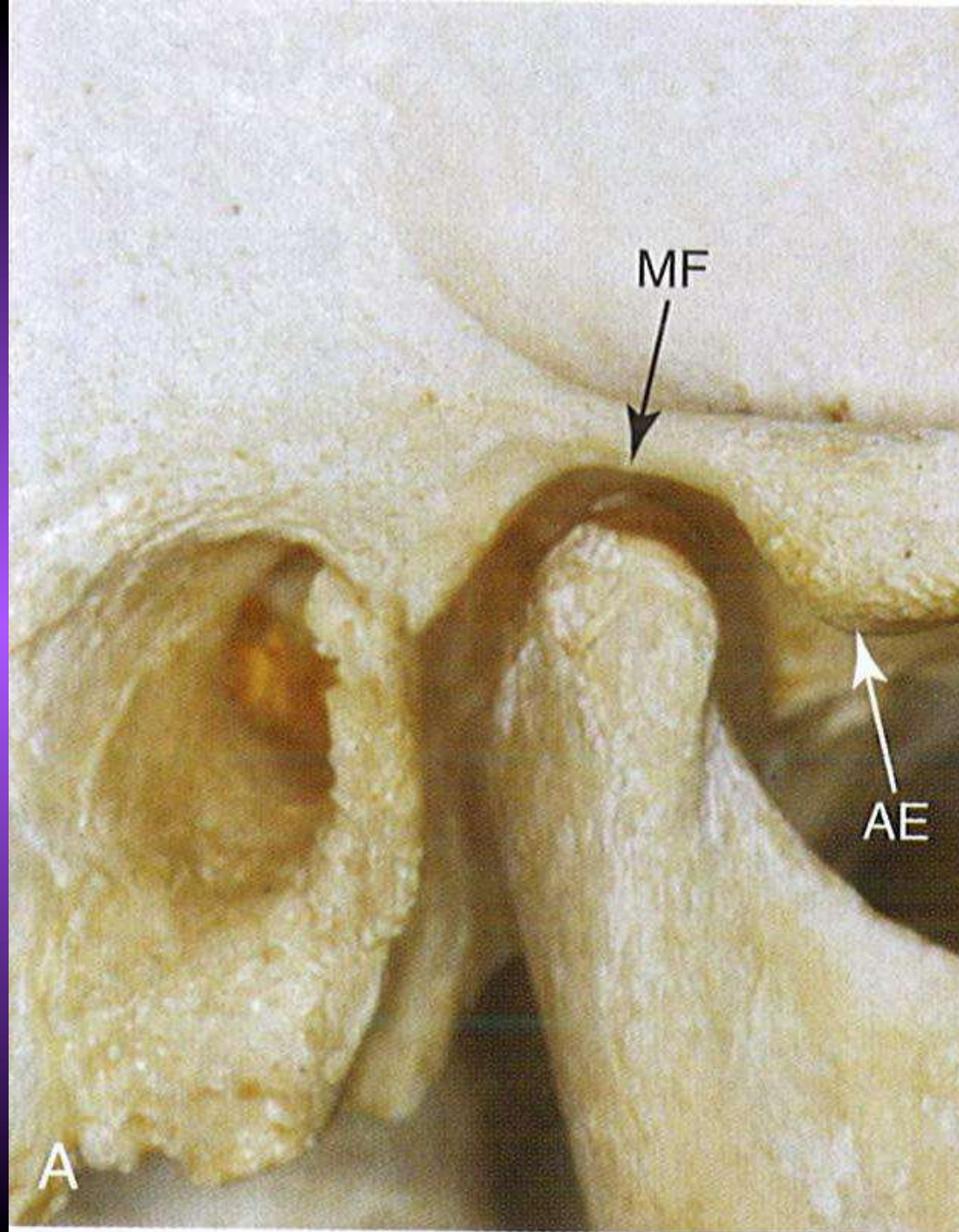




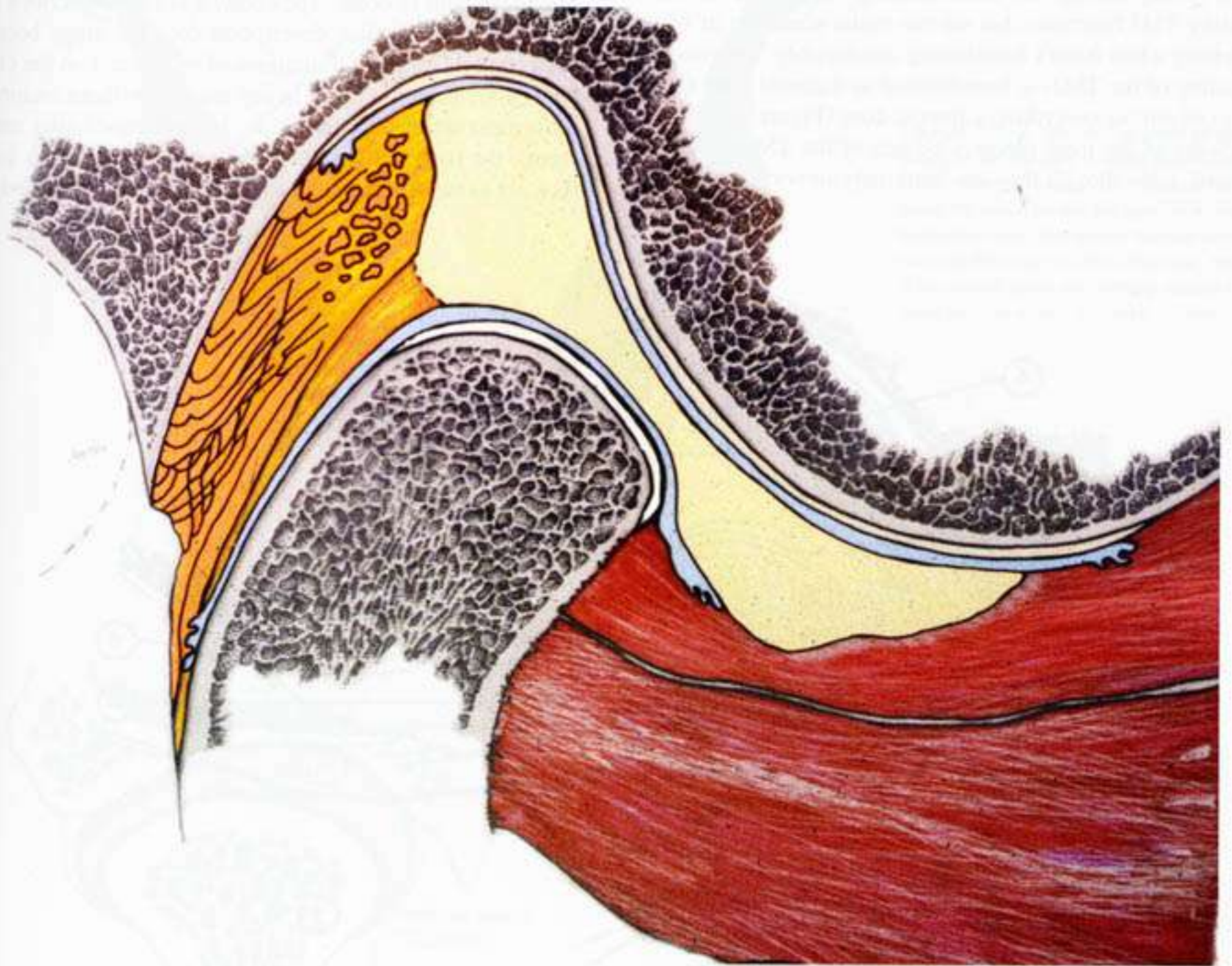
# Mandibular Movements

Relationship of TMJ  
and Associated  
Structures

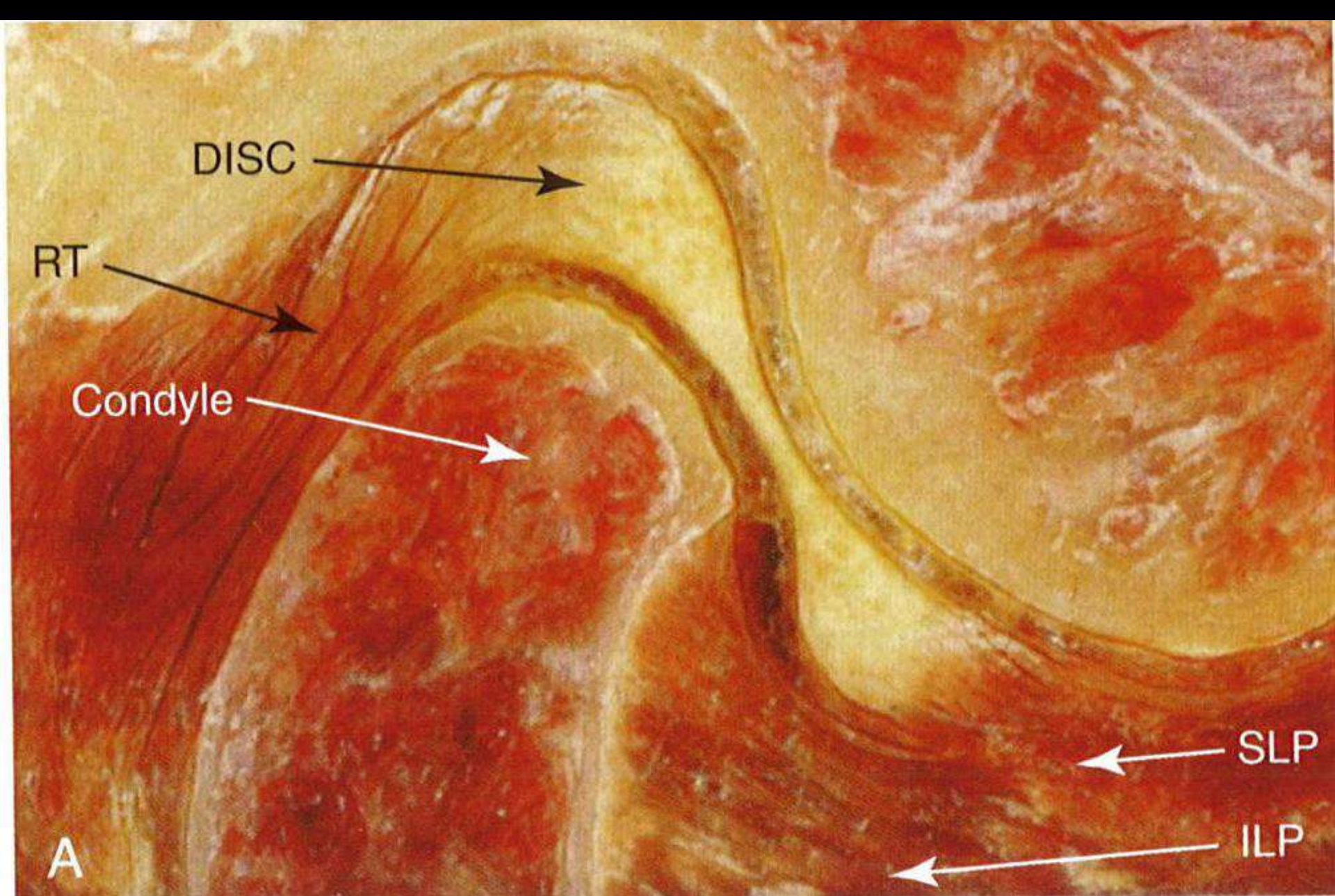




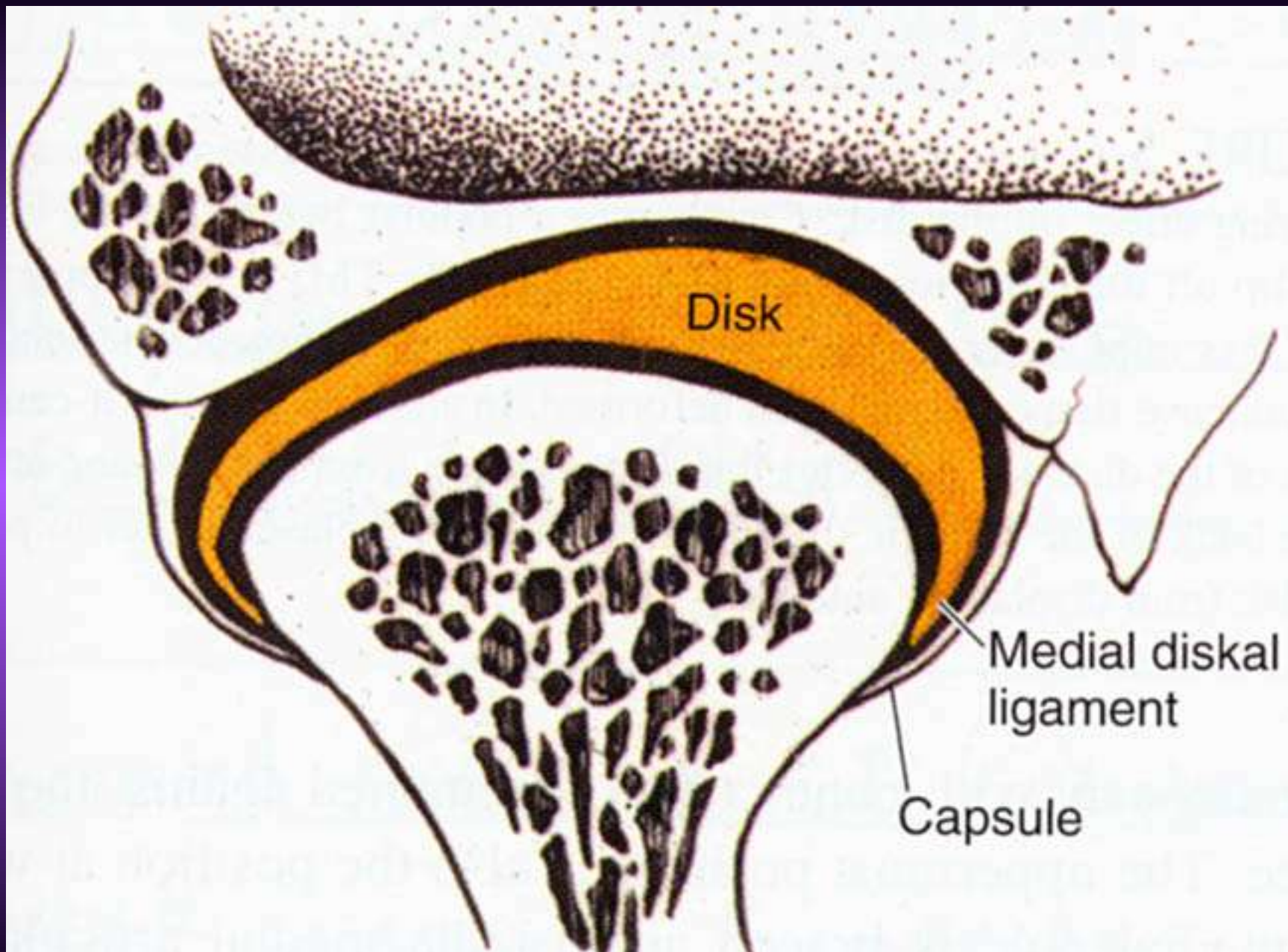




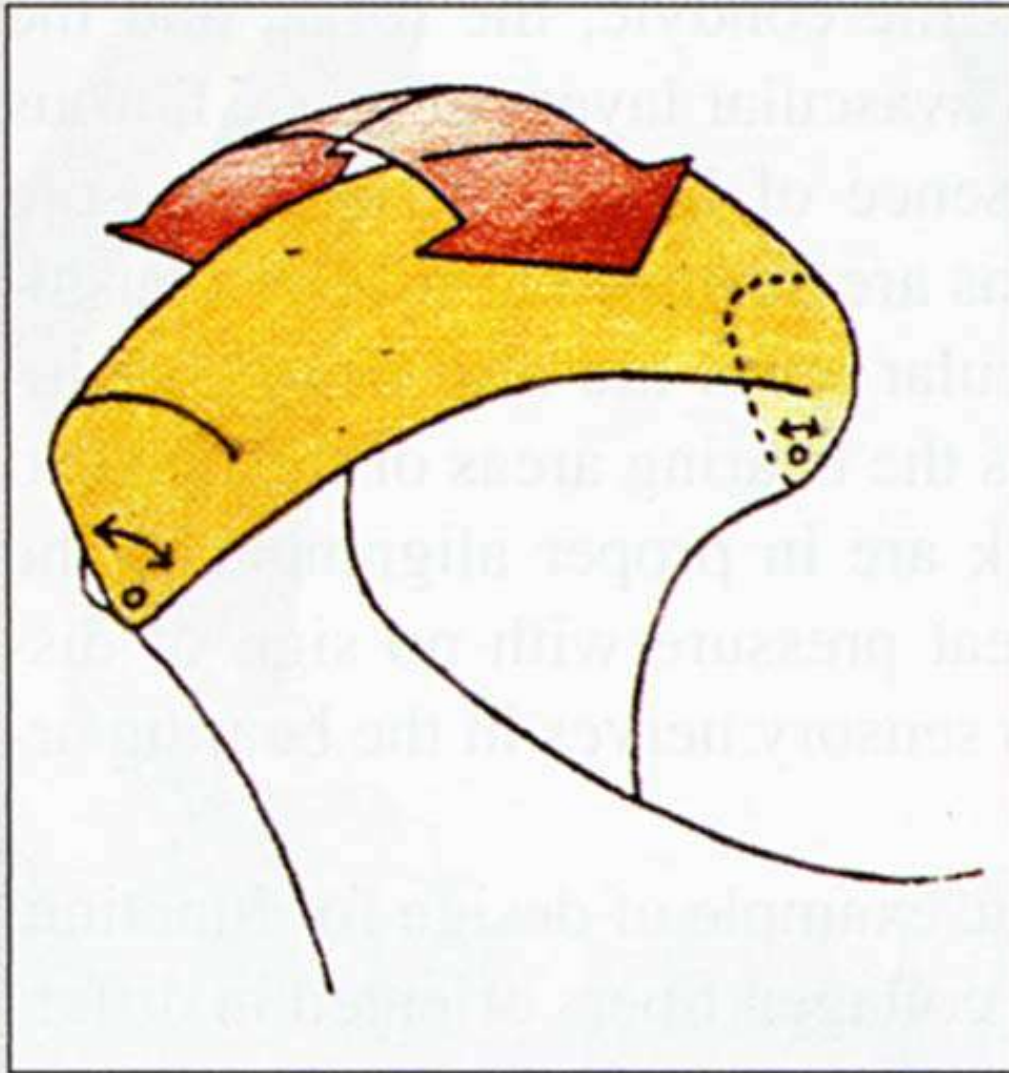




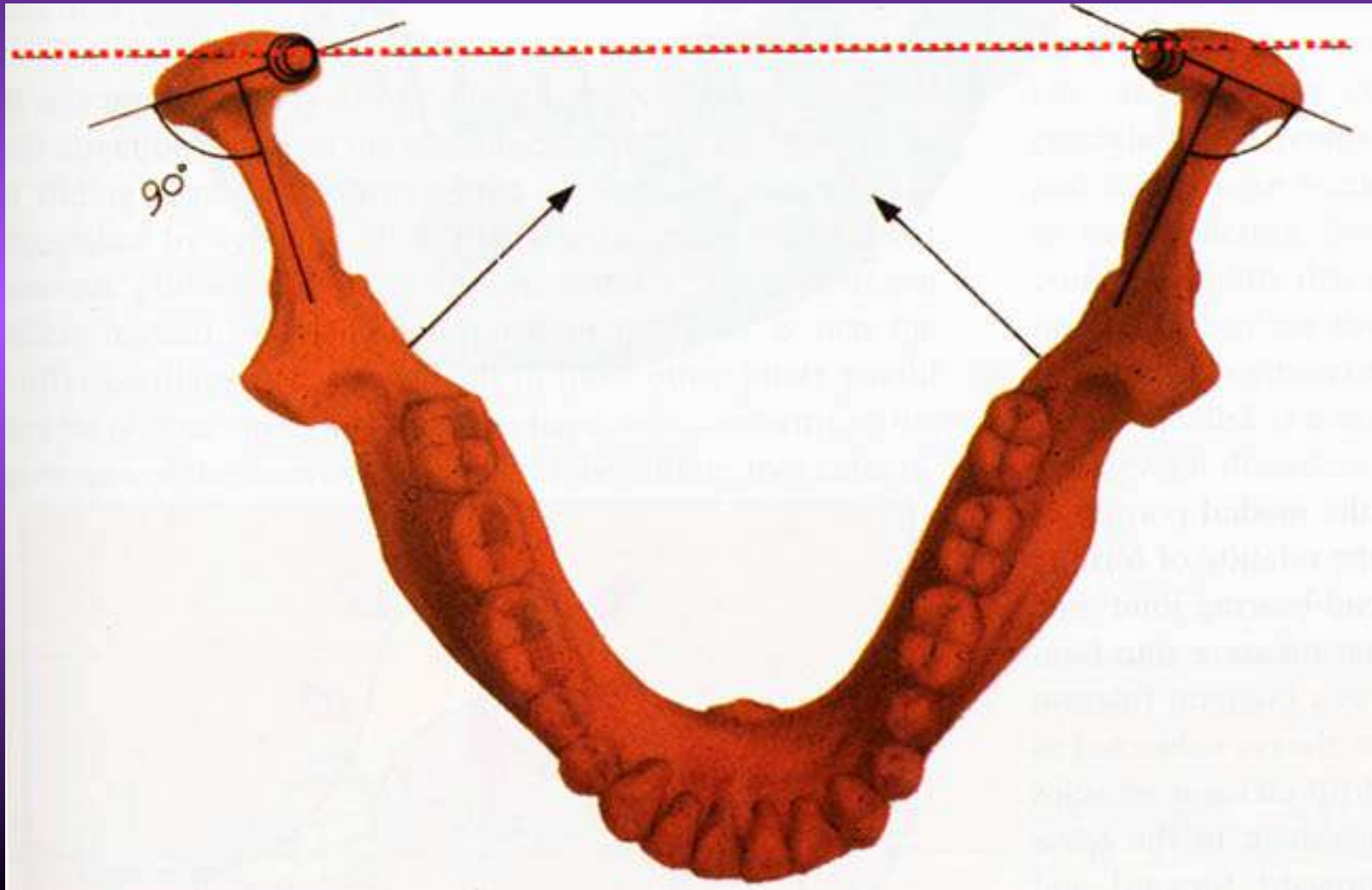




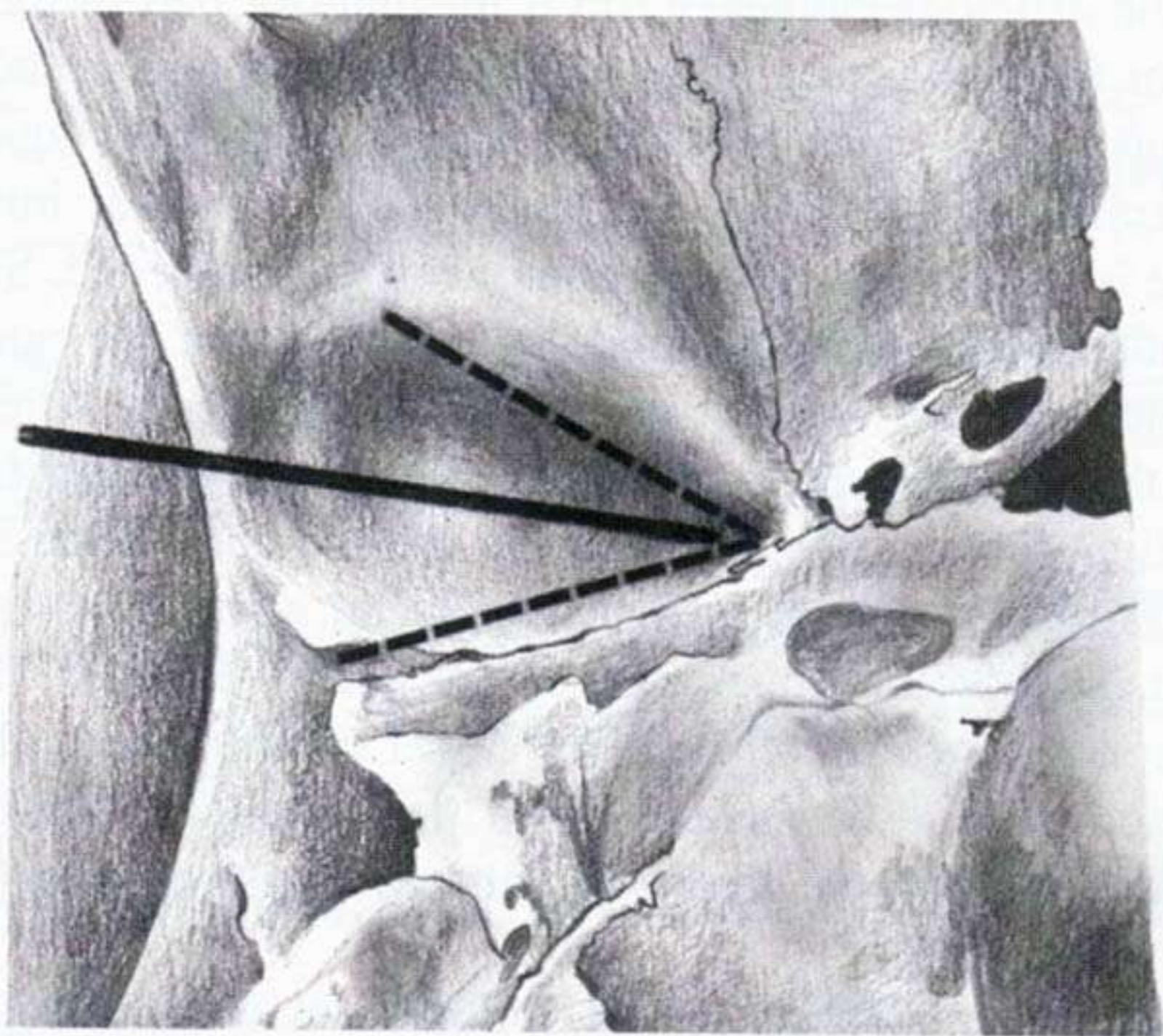
# Disc Adaptability

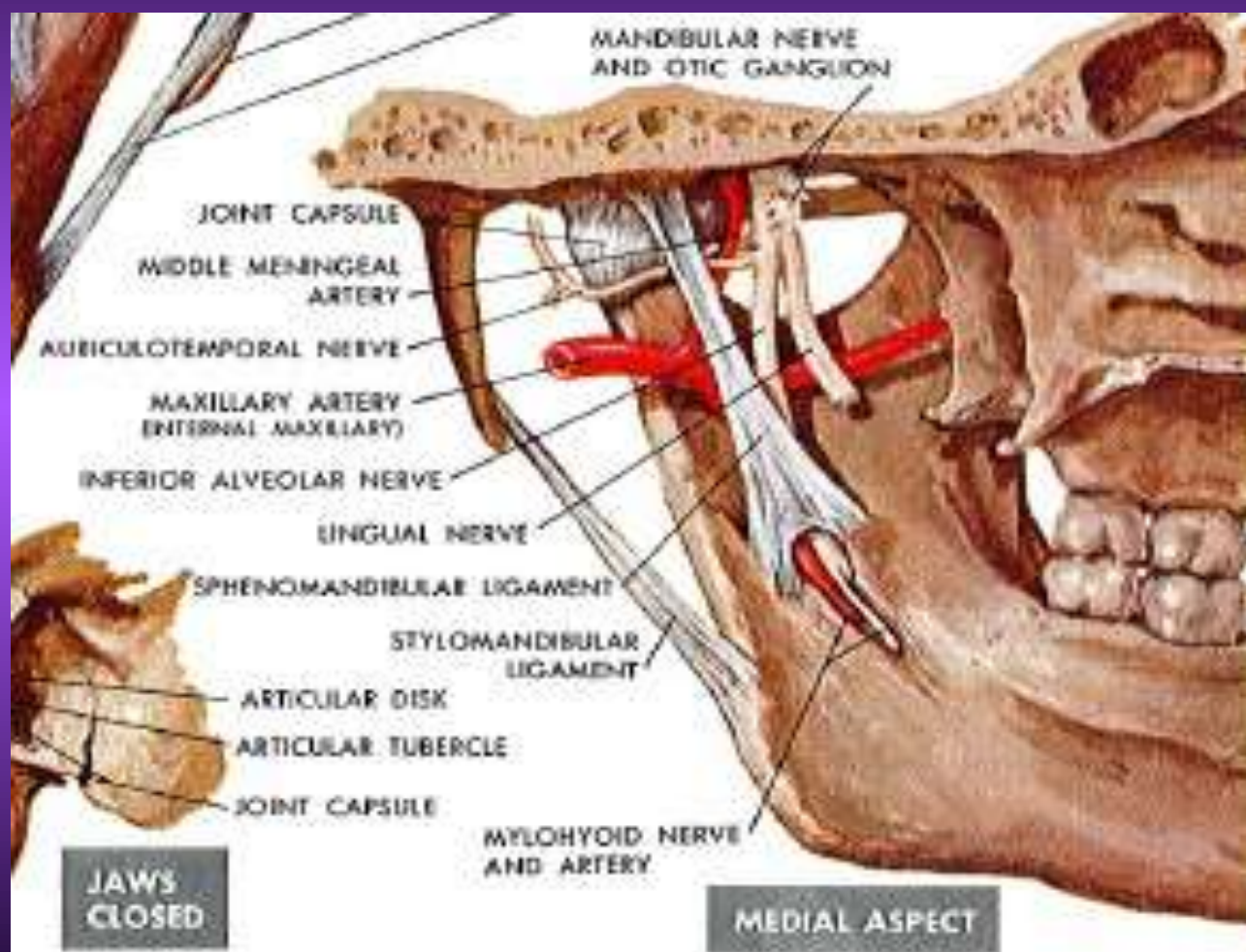


# Fixed Axis of Rotation



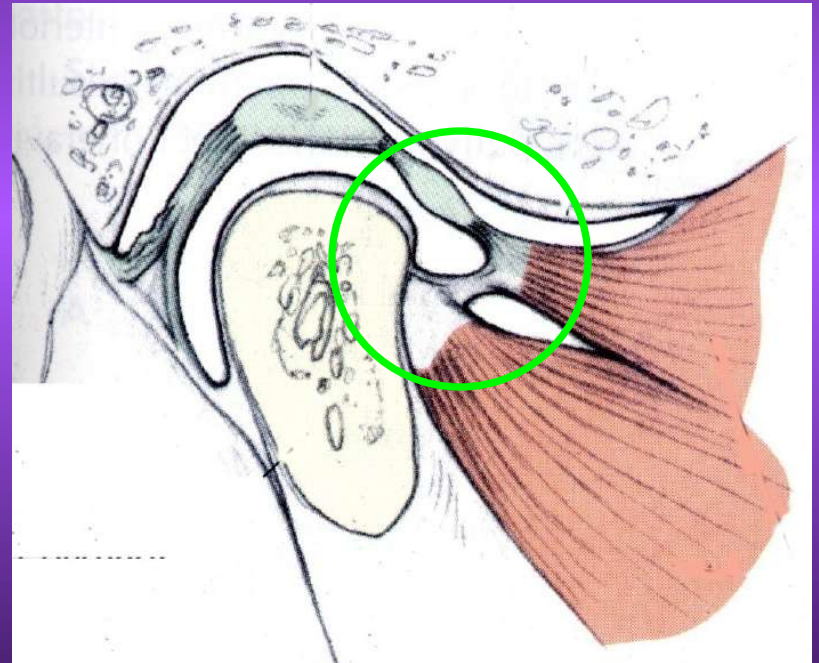






# The Articular Disc

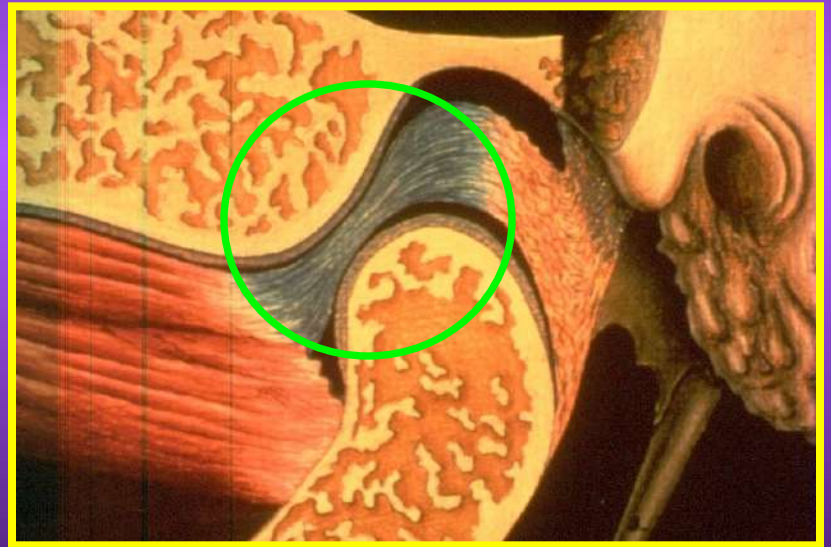
Anteriorly it fuses with the capsule and with the superior lateral pterygoid muscle





# The Articular Disc

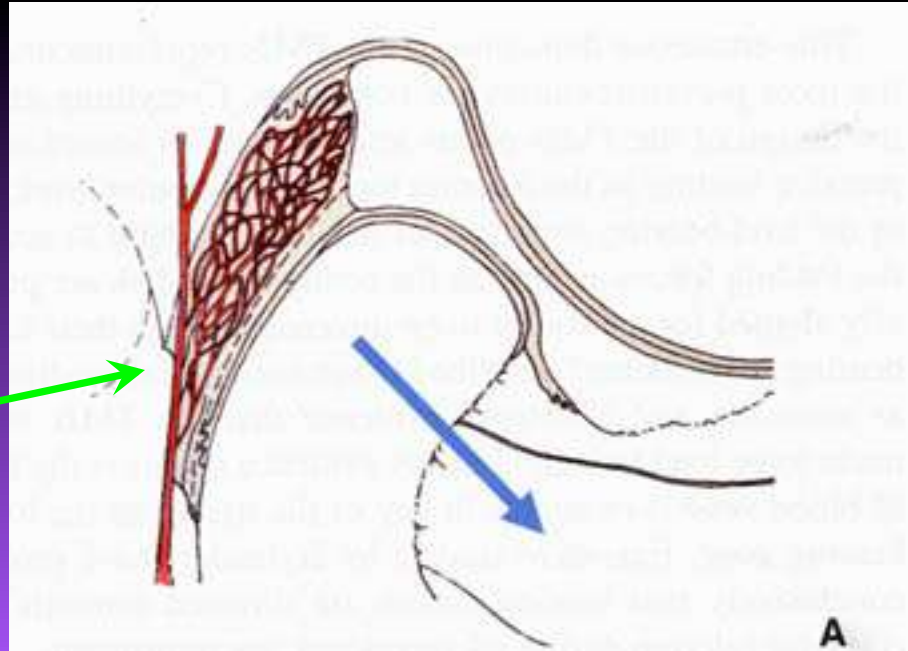
- \* Consists of dense connective tissue
- \* It is avascular and devoid of nerves in the area where articulation normally occurs



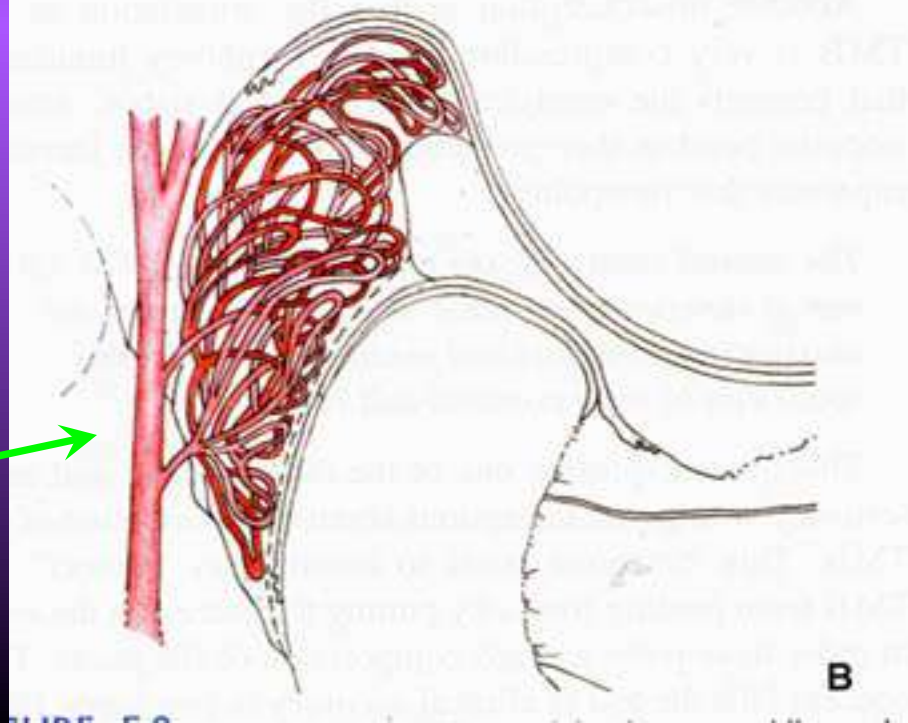


# Arteriovenous Shunt (vascular knee)

Closed position



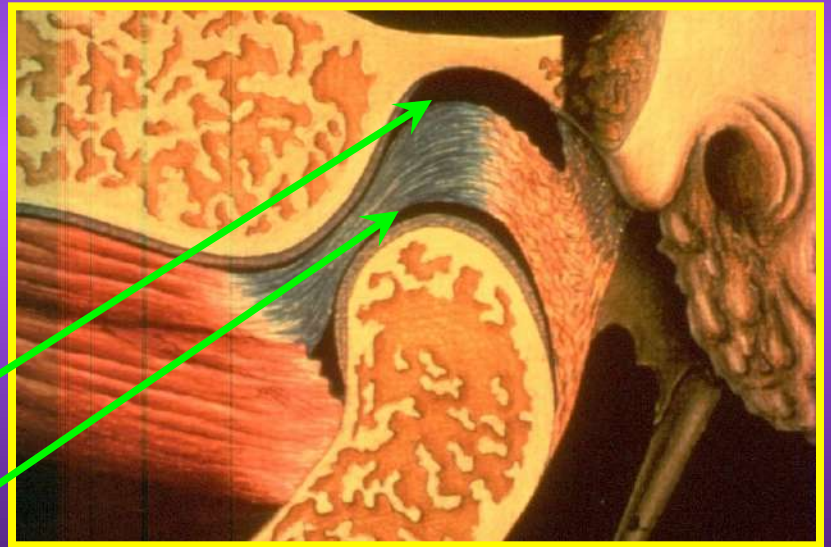
Open position



# What Is Above And Below The Disc

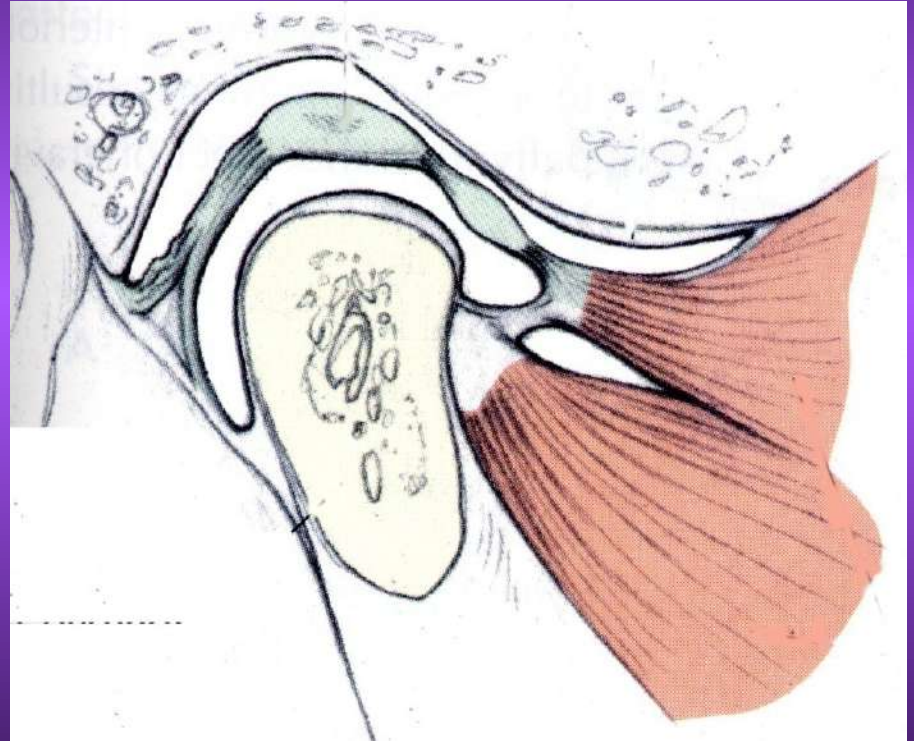
Superior and inferior to the articular disc are two spaces:

- 1) superior synovial cavity
- 2) inferior synovial cavity



# Synovial Cavities

Are bordered  
peripherally by the  
capsule and the synovial  
membranes and are filled  
with synovial fluid  
which provides  
metabolic supply to the  
nonvascular articular  
surfaces

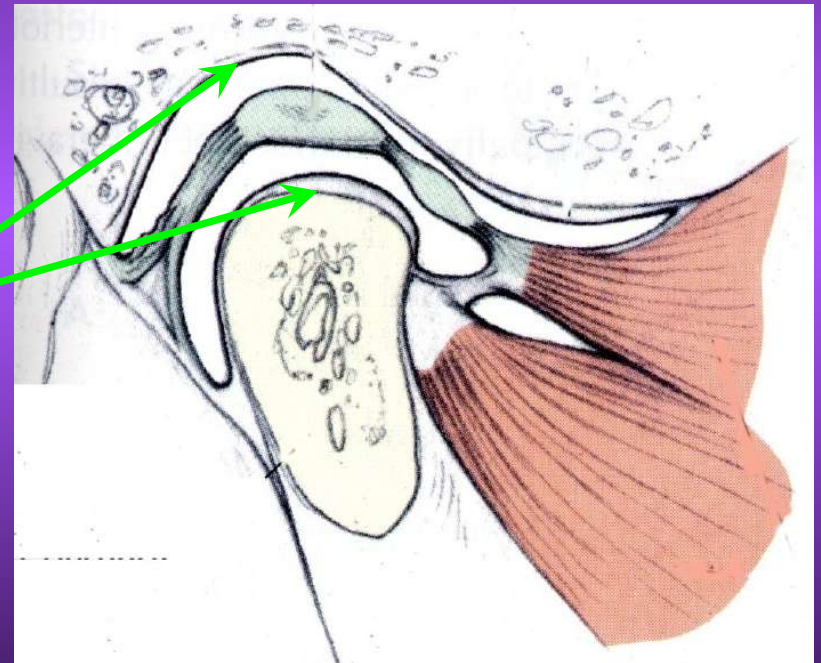


BOUNDARY  
WEEPING



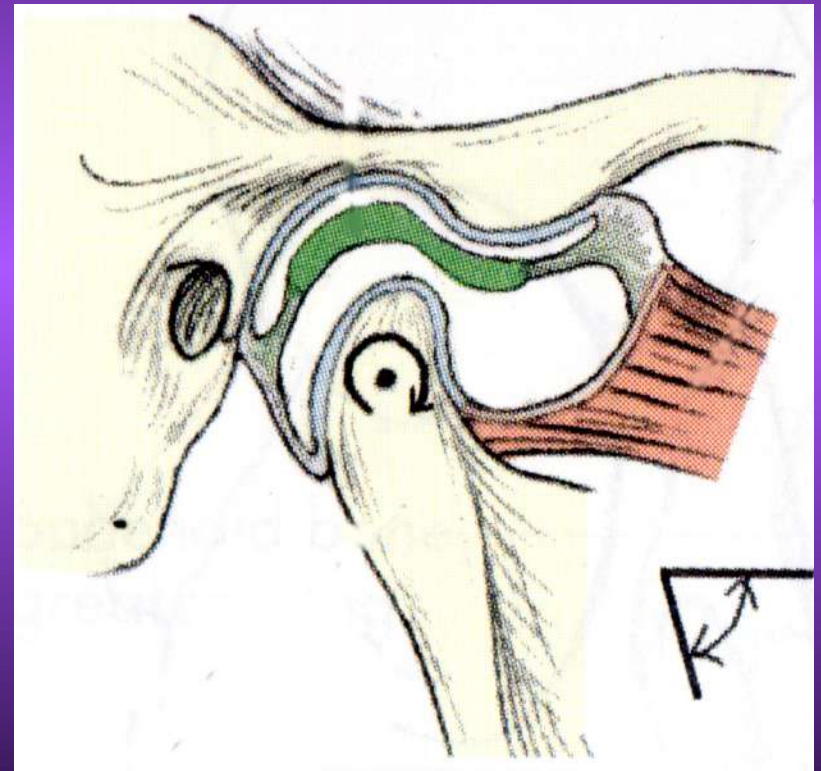
# Covering Of Articulating Surface

The surface of the condylar processes and fossae are covered with avascular fibrous tissue (in contrast to most other joints, which have hyaline cartilage)



# Ginglymoarthrodial

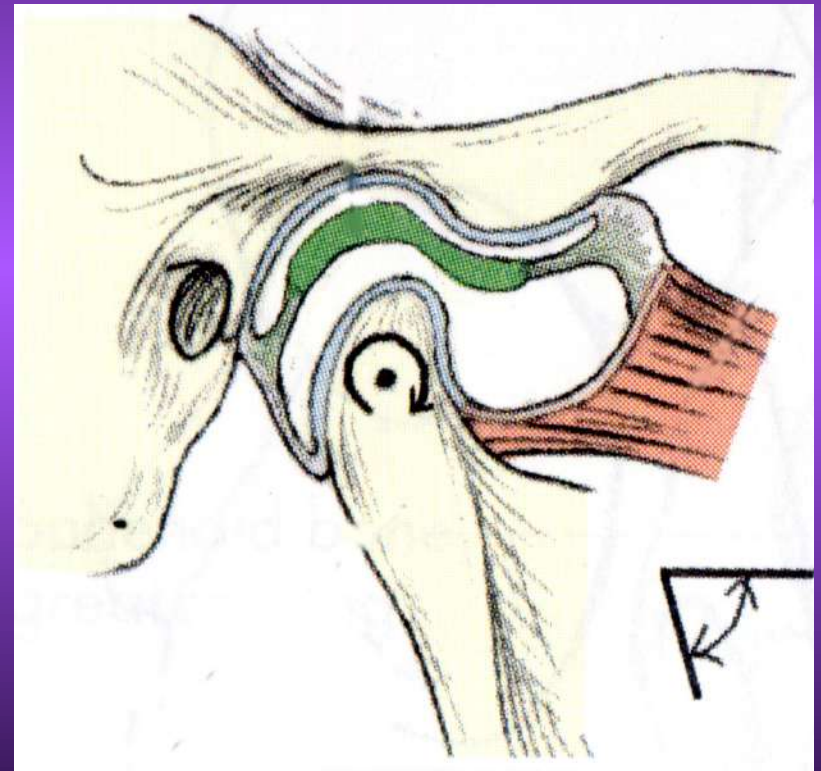
Both joints can be described as a capable of both a hinging and a gliding articulation



# Mechanisms Of The TMJ

## 1. Hinge

During the first stage of jaw opening, the condylar process rotates around an imaginary horizontal hinge axis. This movement takes place in the lower joint compartment.

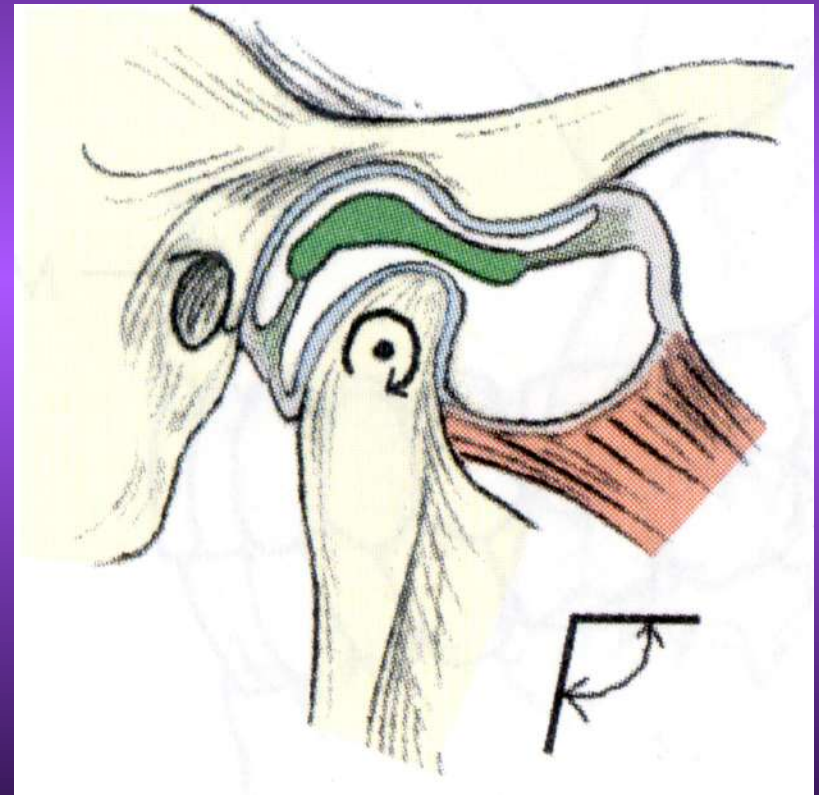




# Mechanisms Of The TMJ

## 2. Translation

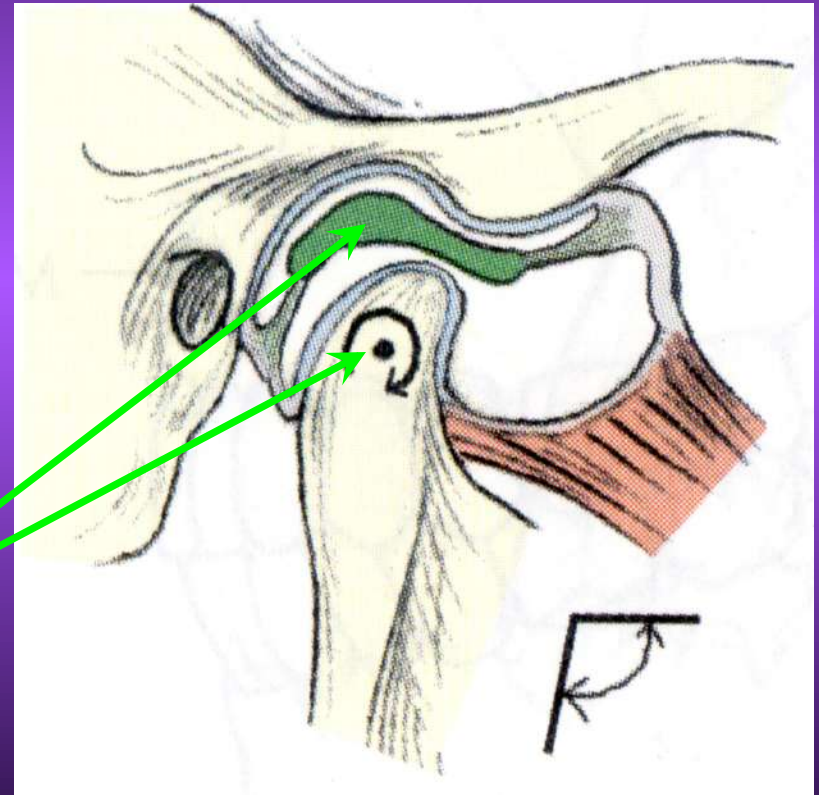
In the second stage of opening, the condyle slides forward along the articular eminence and abuts the articular tubercle, with some additional hinging. This movement takes place in the upper joint compartment.



# What Happens During Mandibular Movement?

Because of its firm attachment to the poles of each condylar process, the disc follows condylar movement during both hinging and translation

CR 15-20 mm  
Pure Rotation

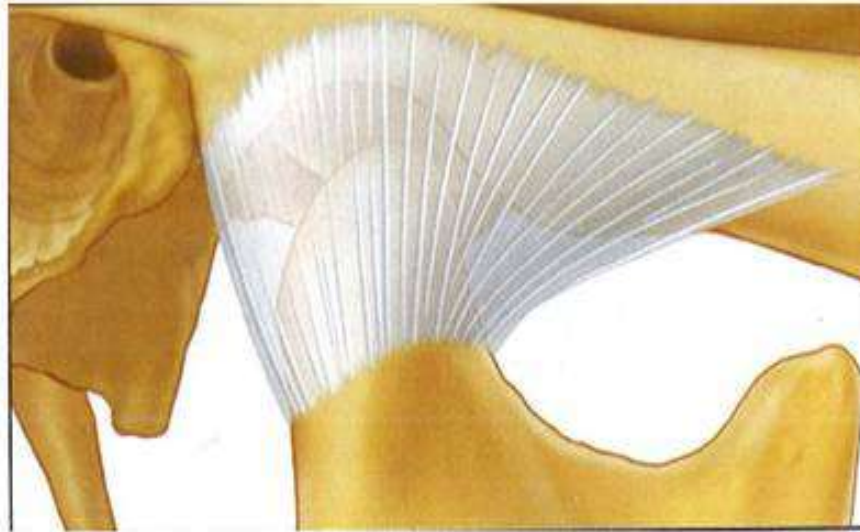


# Ligaments Of The TMJ

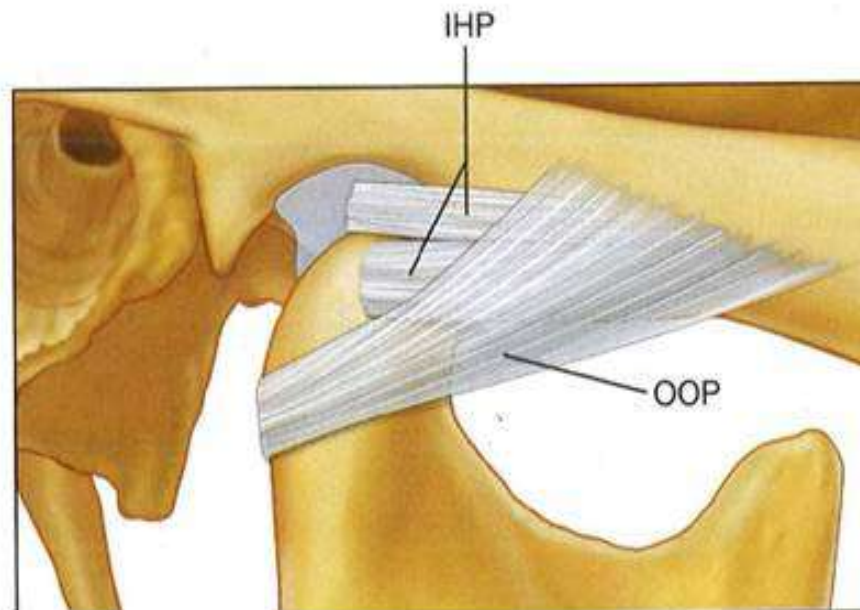
The TMJ is supported by three functional ligaments along with two accessory ligaments that offer passive restraint and limit border movements.

- 1) collateral
- 2) capsular
- 3) temporomandibular
- 4) sphenomandibular
- 5) stylomandibular



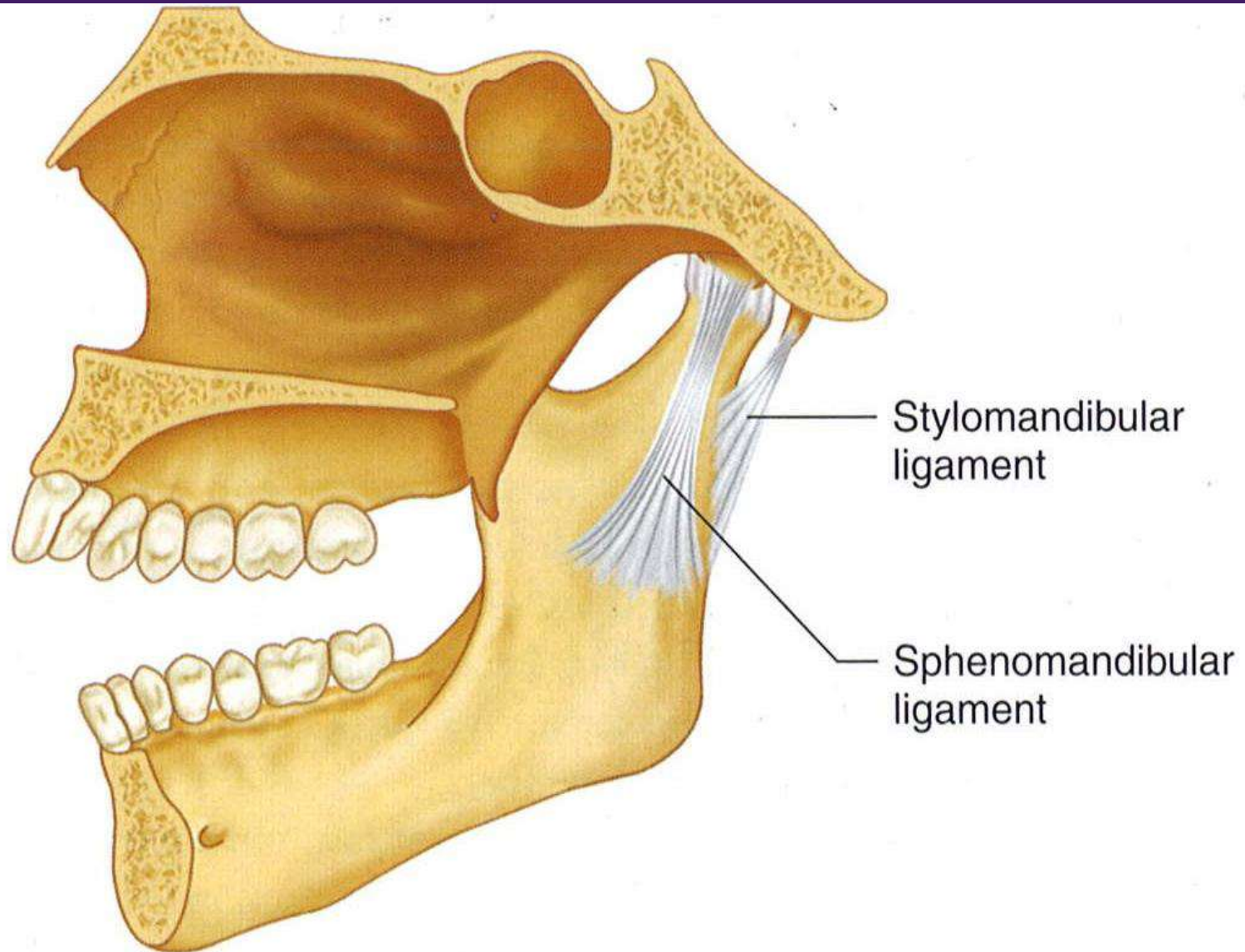


1-19 Capsular ligament (lateral view)

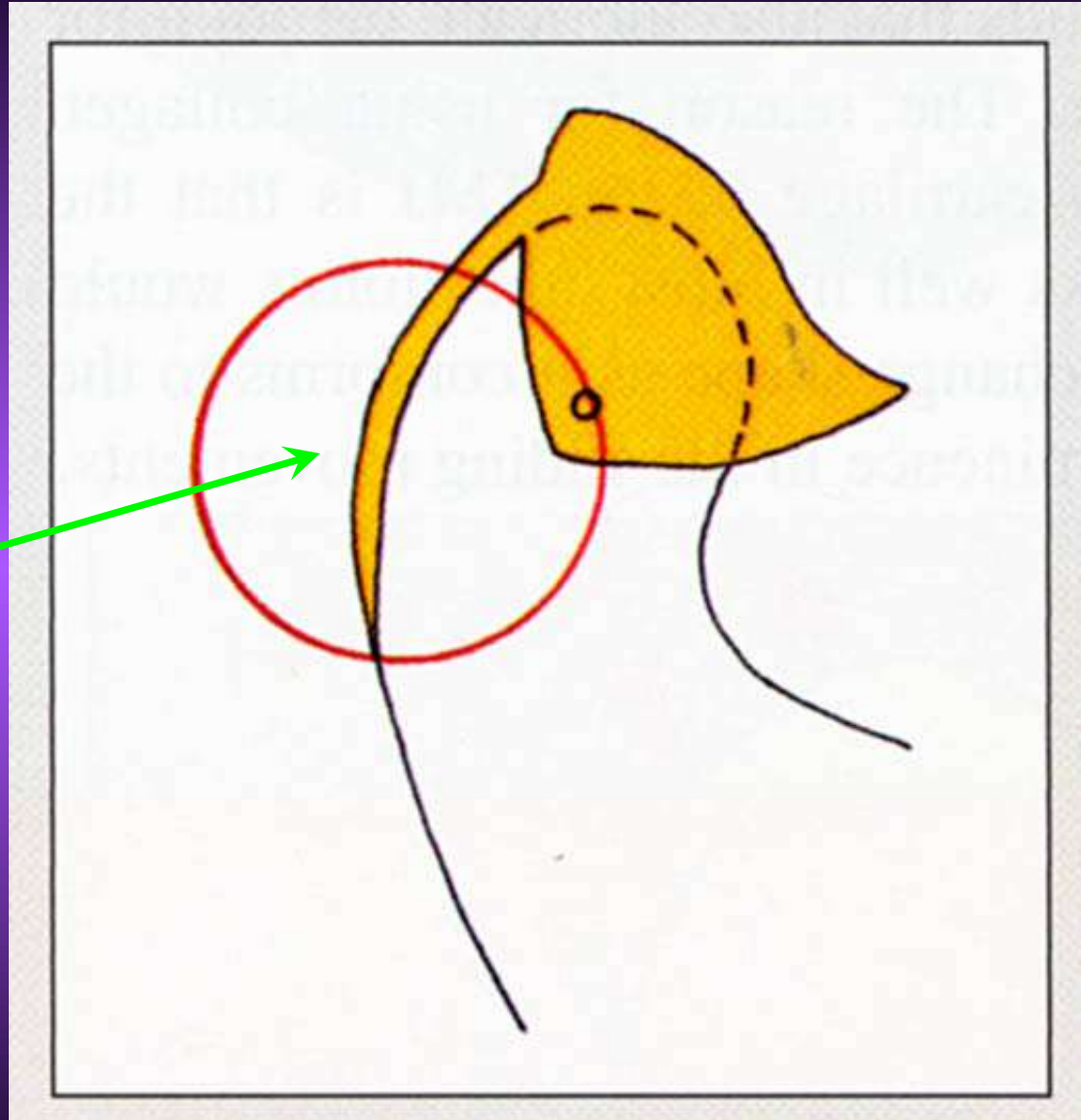


1.20 TM Ligament (lateral view)

# Eagles Syndrome

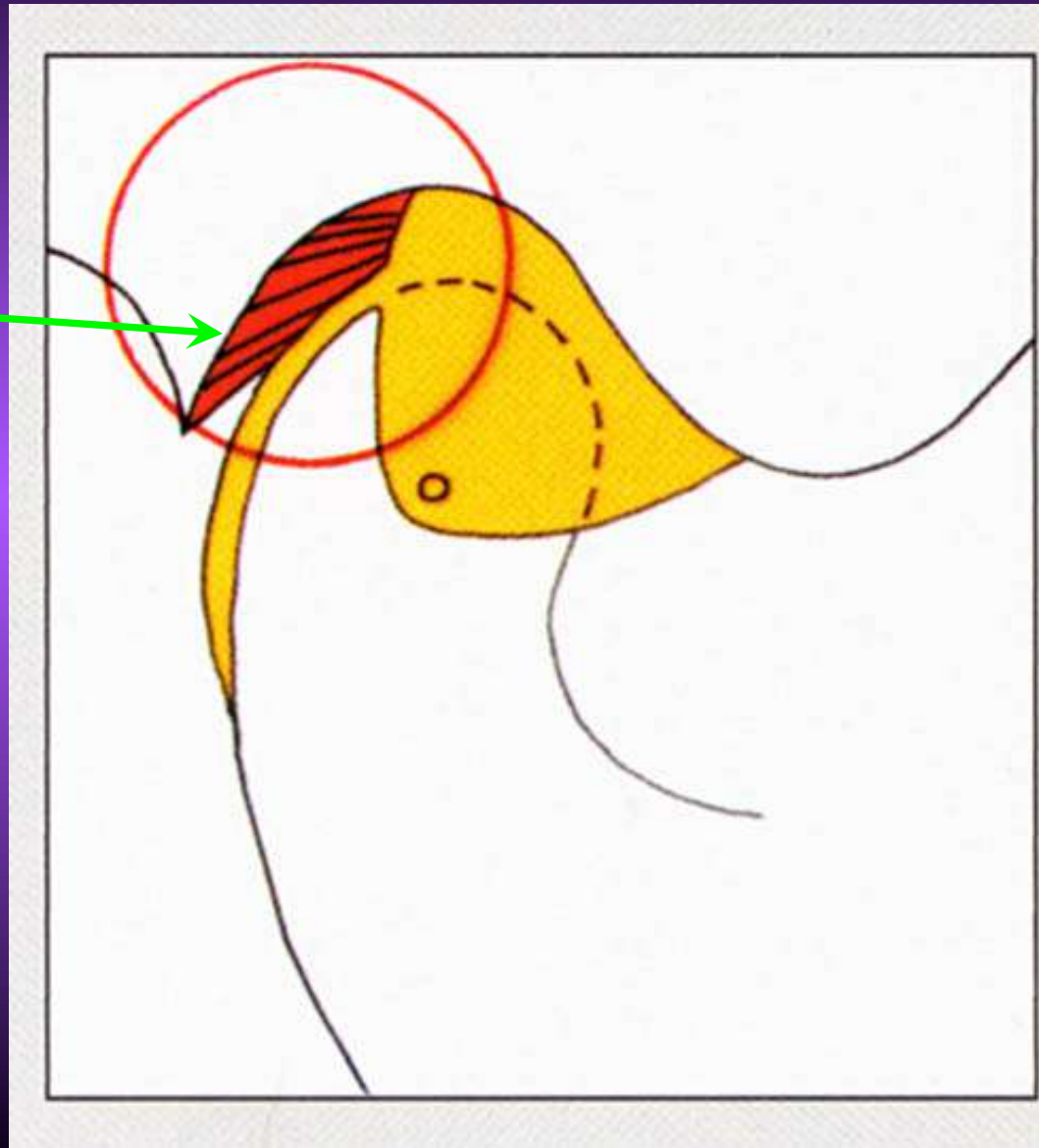


Posterior ligament  
prevents anterior  
over rotation

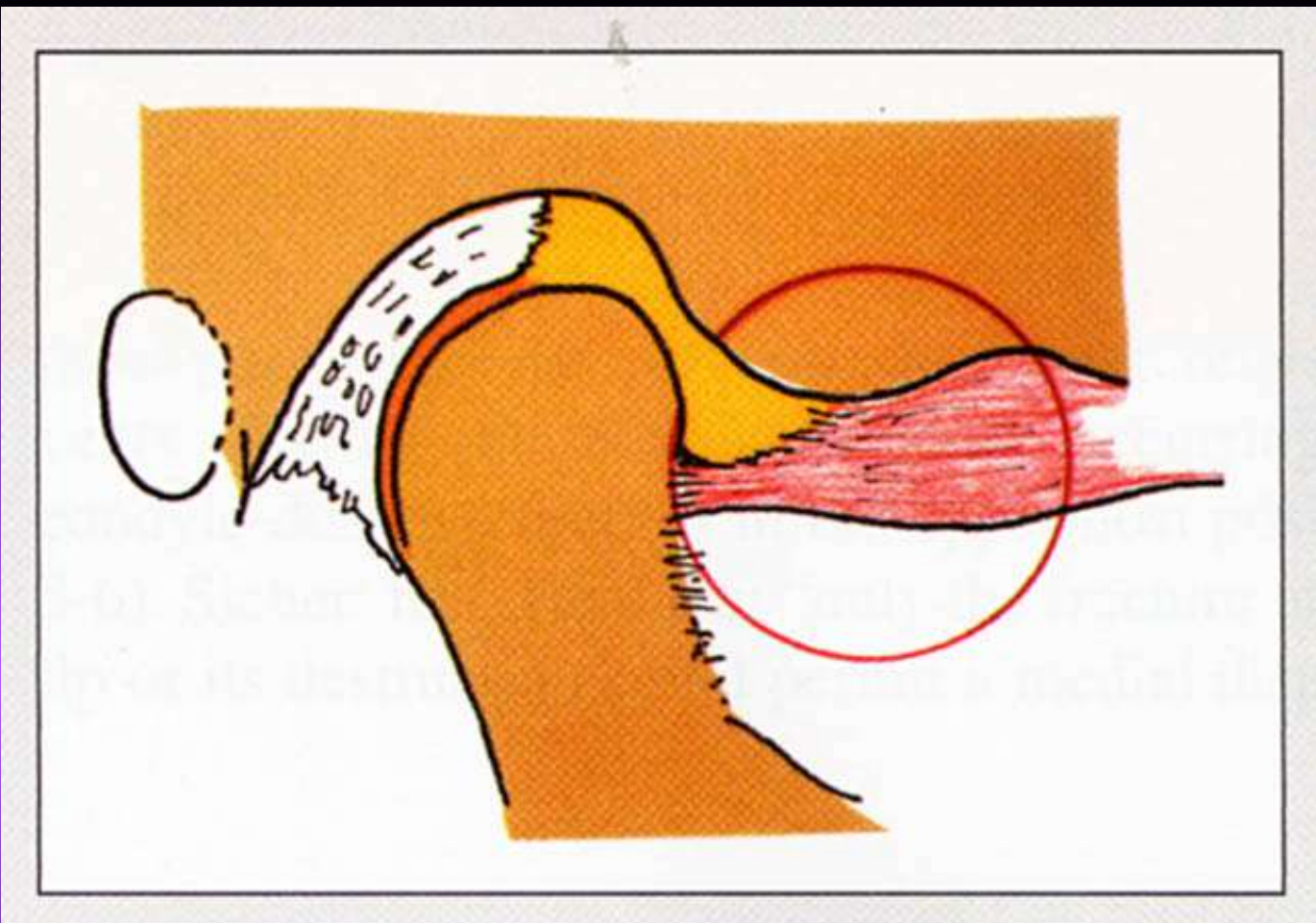


Superior elastic  
stratum

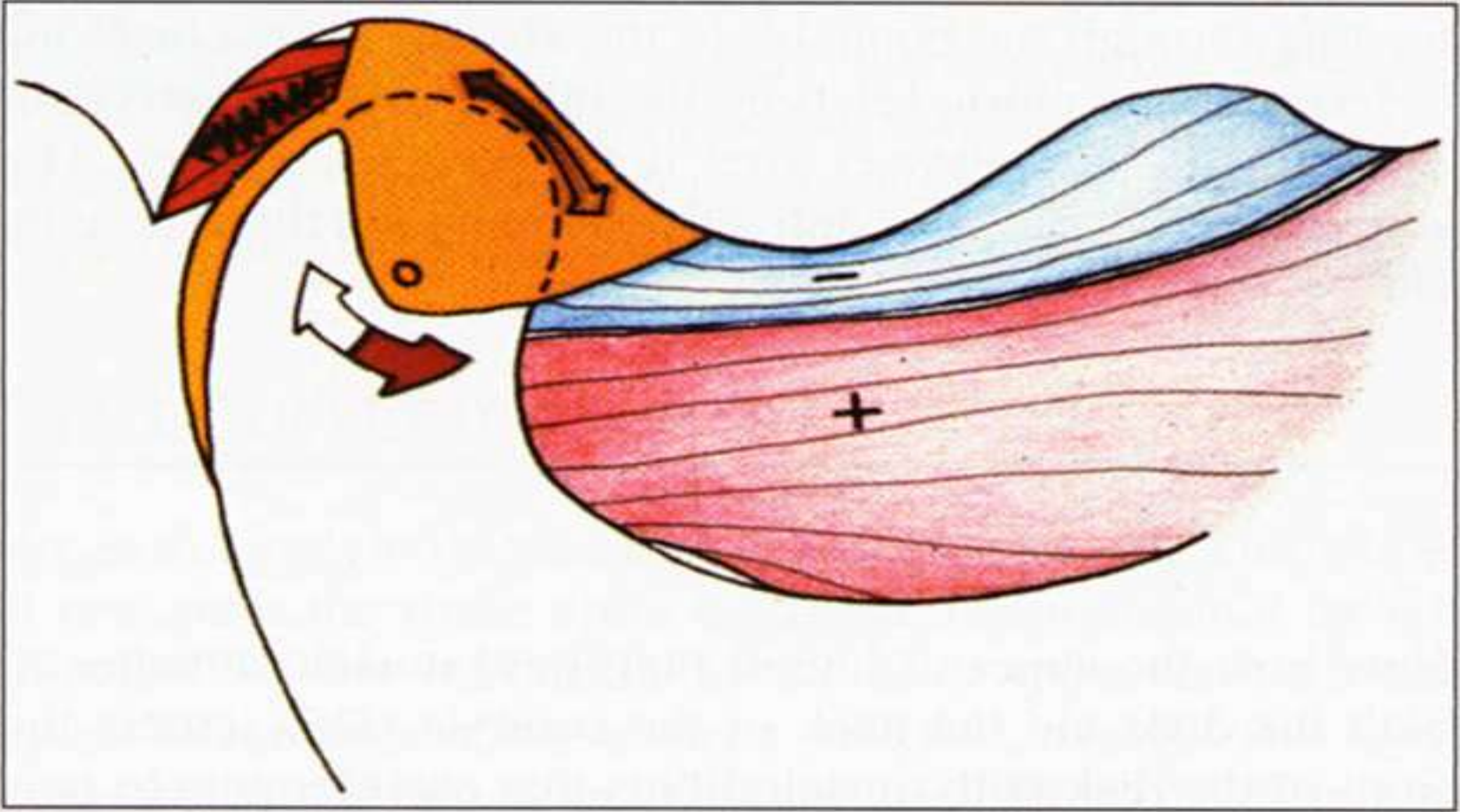
Binds the disc to the  
temporal bone



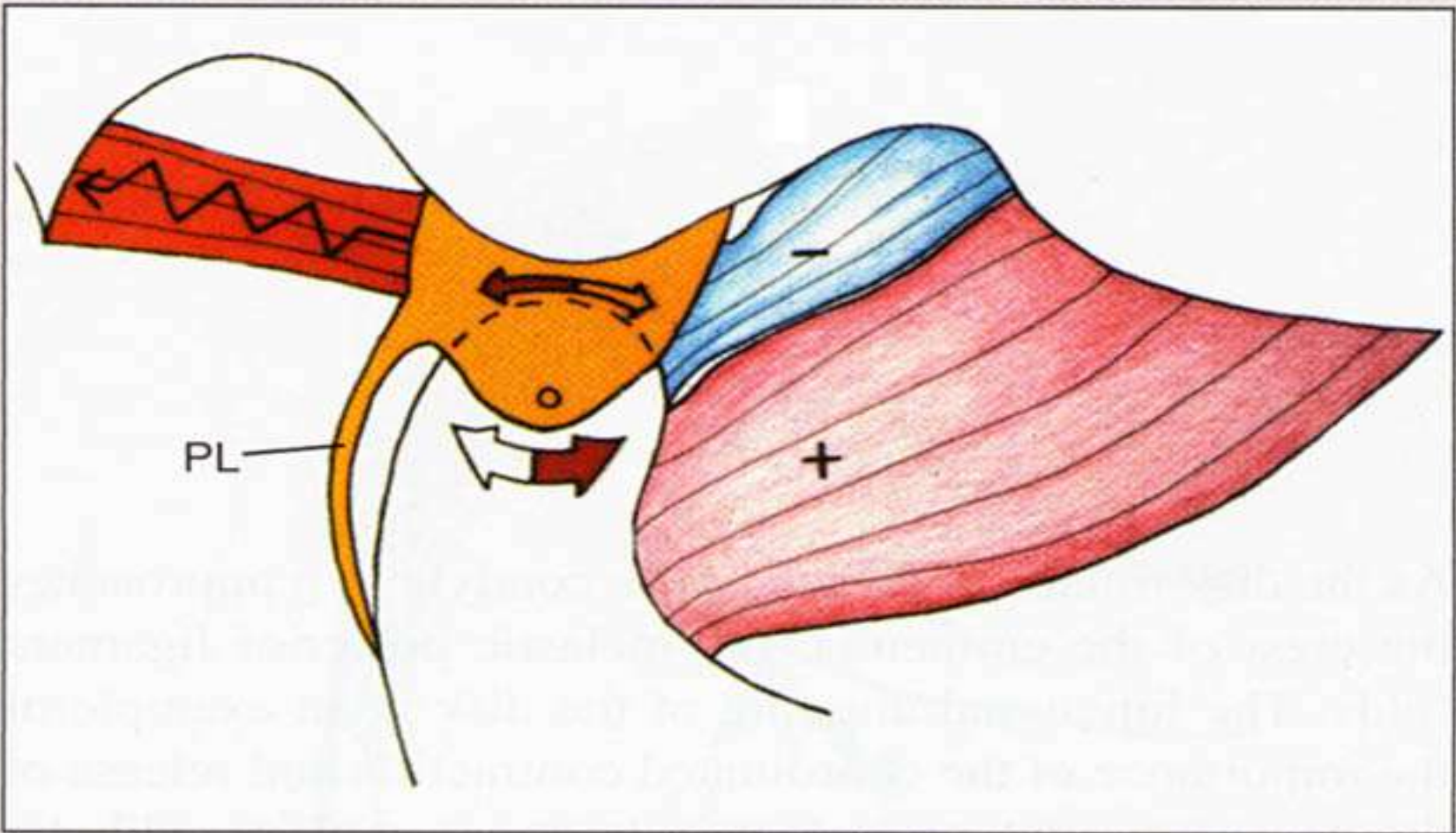




Anterior force supplied by the inferior belly of the lateral pterygoid muscle

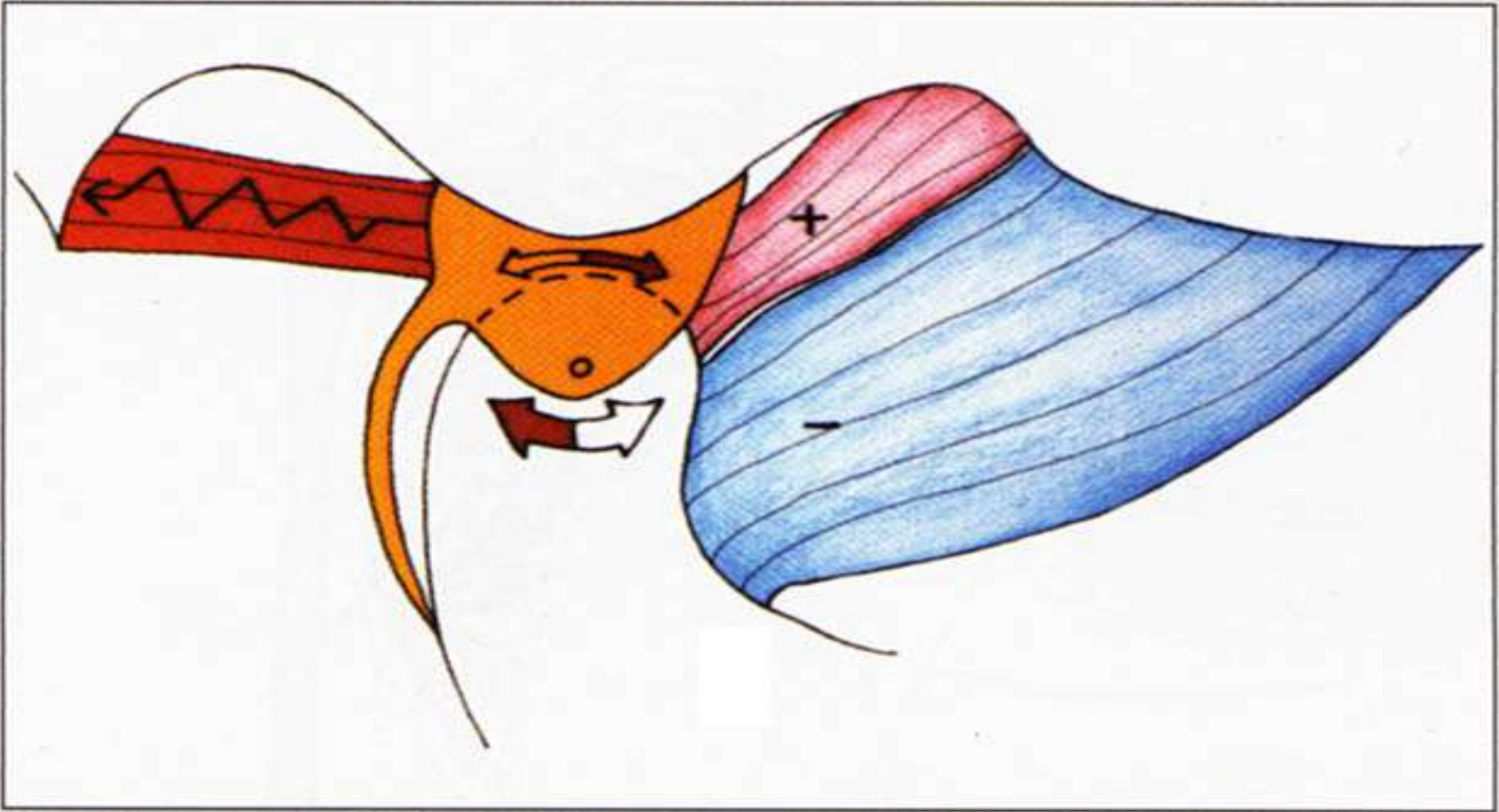


At the start of opening the condyle is in the most Superior – Anterior position against the disc on the slope of the eminence as far as the PL allows with the muscles in a stabilized position



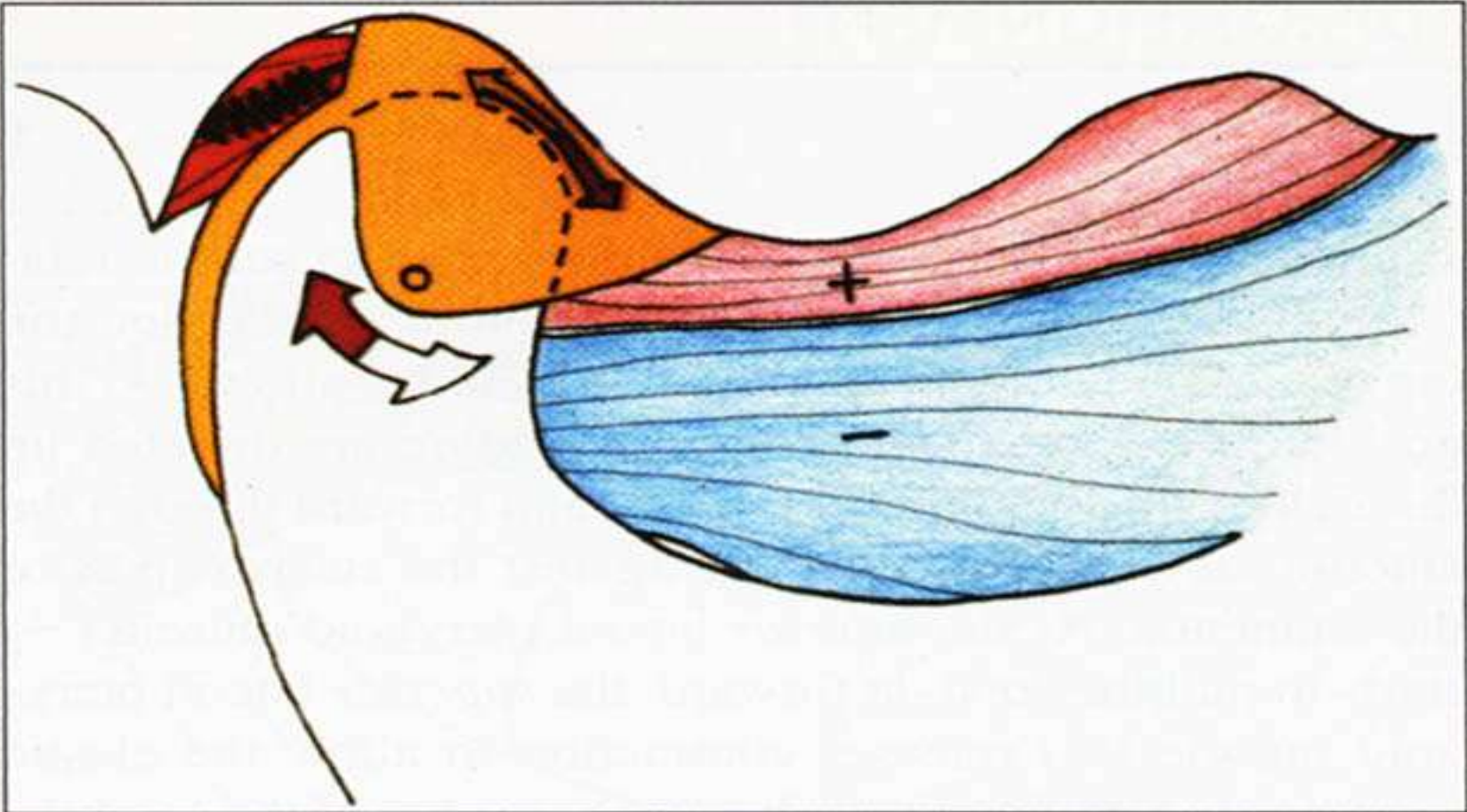
At maximum opening  
the non elastic PL becomes lax



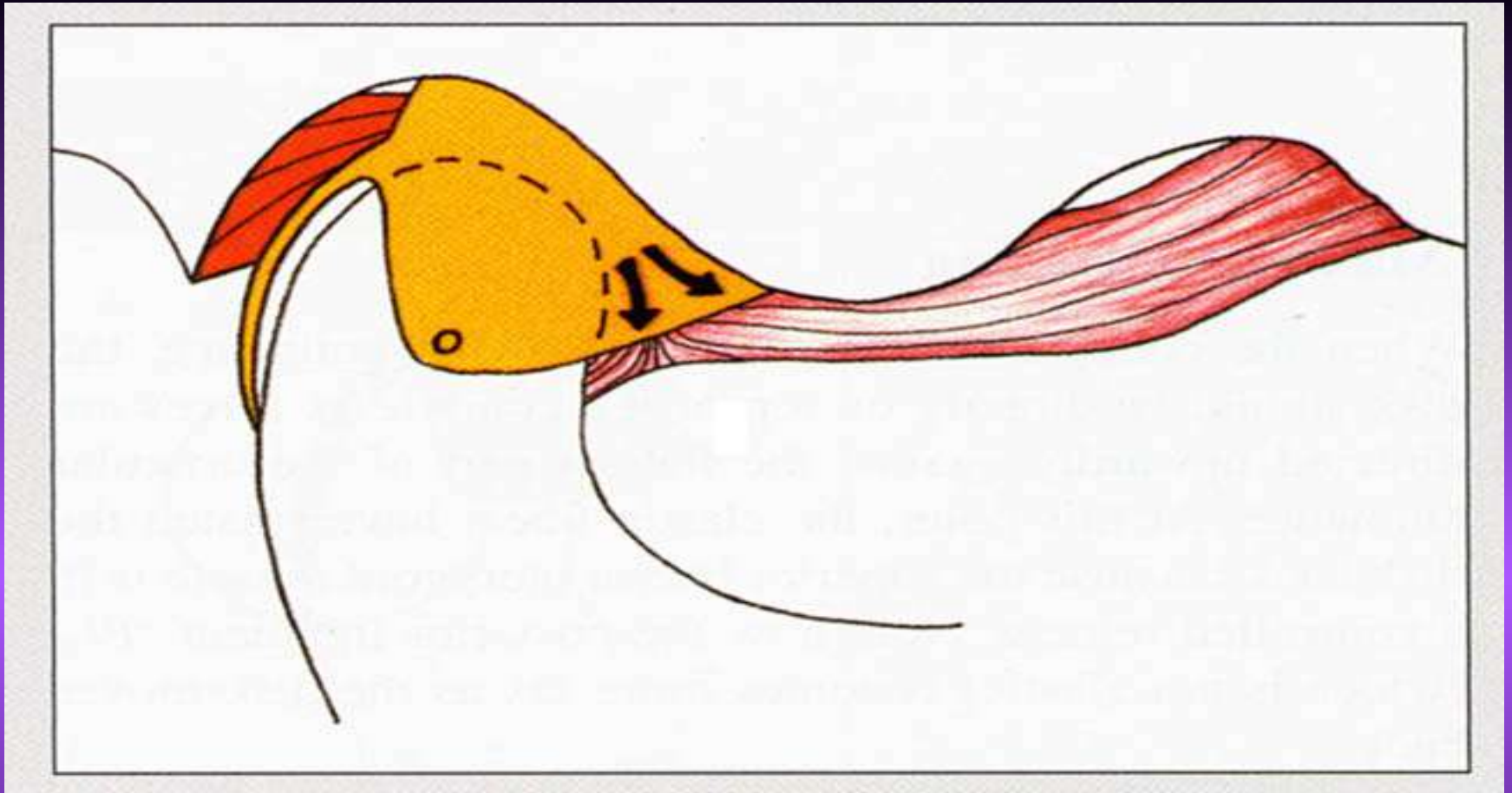


During closing the disc is pulled forward as  
the condyle returns to CR





At the closed position CR is regained with the disc in its stabilized position

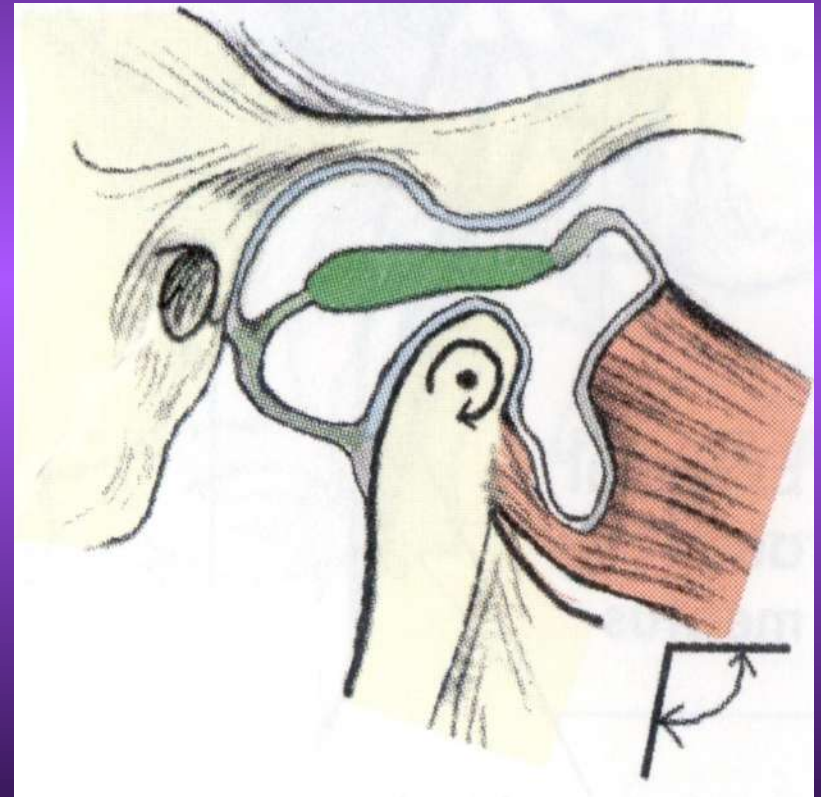


Fibers of the superior lateral pterygoid which are attached to the disc and condylar head promotes harmony of movement

# Mechanisms Of The TMJ

It is possible for the condylar process and disc to slide too far forward, beyond the articular tubercle, “locking” the jaw in an open position.

**SUBLUXATION**



Forced Opening



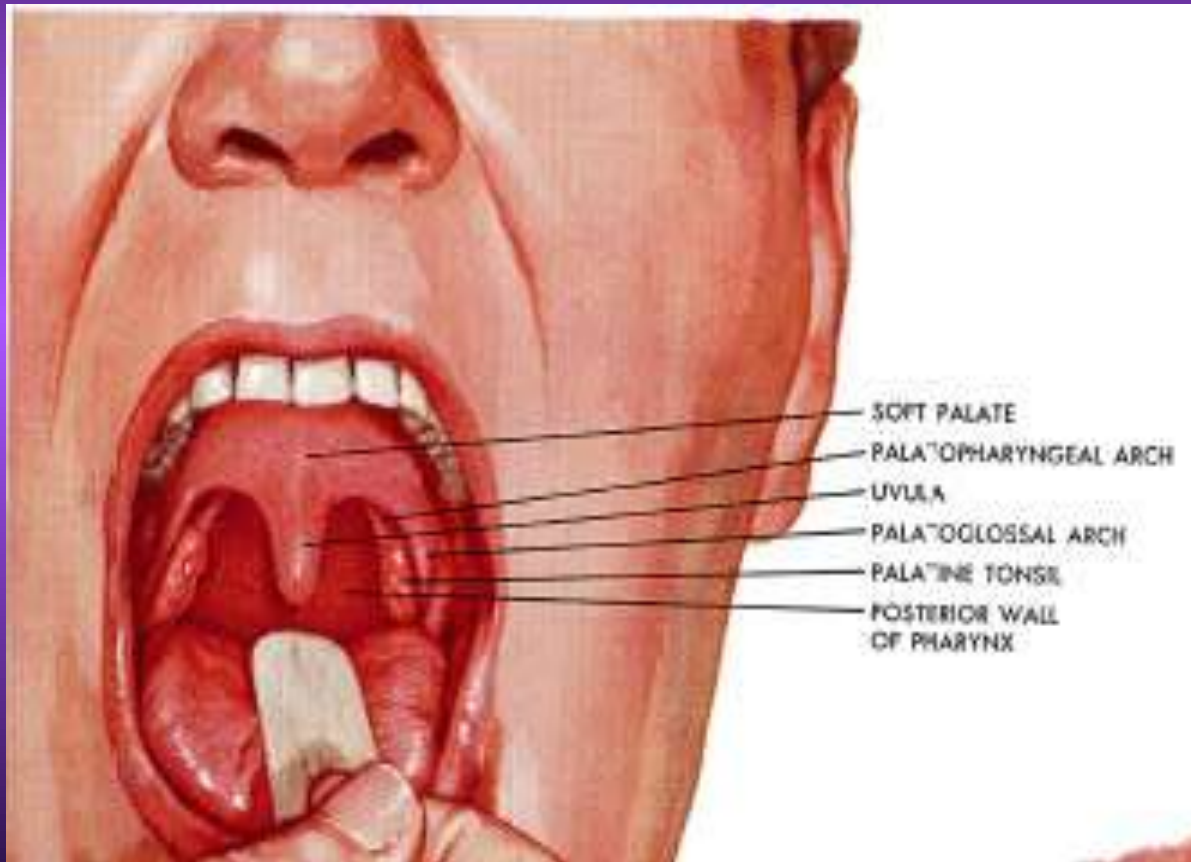
[\*www.AlilaMedicalMedia.com\*](http://www.AlilaMedicalMedia.com)

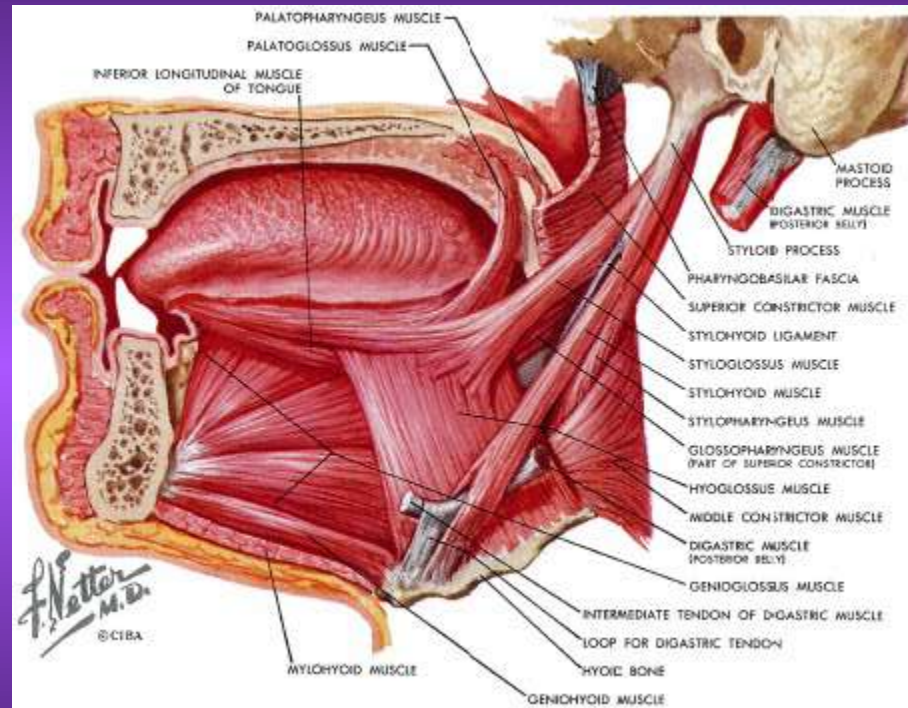




# Basic Functional Anatomy of the Gnathostomatic System and it's Relationship to Dental Sleep Medicine

Eugene Santucci DDS, MA, FACD





Hypoglossal Nerve /Genioglossus muscle /InSpire Implant



**Figure 9. Mallampati Scale**<sup>[28]</sup>



**Class I**

Full visibility of tonsils, uvula, and soft palate



**Class II**

Visibility of hard and soft palate, upper portion of tonsils and uvula



**Class III**

Soft and hard palate and base of the uvula are visible



**Class IV**

Only hard palate visible

# Mallampati Score / OSA

One point increase in Mallampati score results in 5 additional AHI events per /hr

One point increase adds 2 fold chance for OSA

These findings are irrespective of BMI, airway anatomy or medical history

SLEEP 2006;29(7): 903-908



Position I



Position IIa



Position IIb



Position III



Position IV

## FRIEDMANS TONGUE POSITION CLASSIFICATION

# Tongue - Clinically

Surface coating

Size in relation to maxillary/mandibular space

Border, smooth or scalloped

Oropharynx, visible or obstructed

Mallampati, Friedman, classification



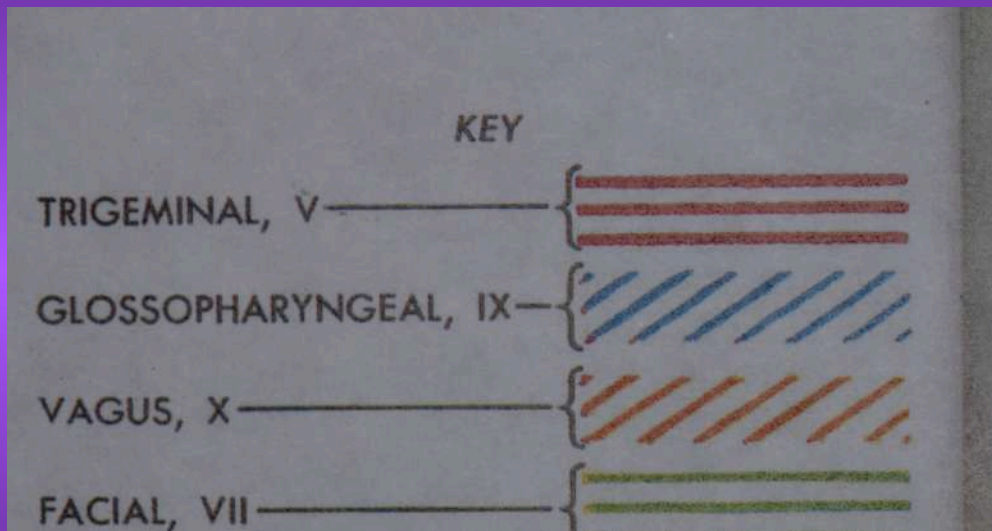
# Tongue Anatomy, Crenation

Presence of scalloping relates to Mallampati score.

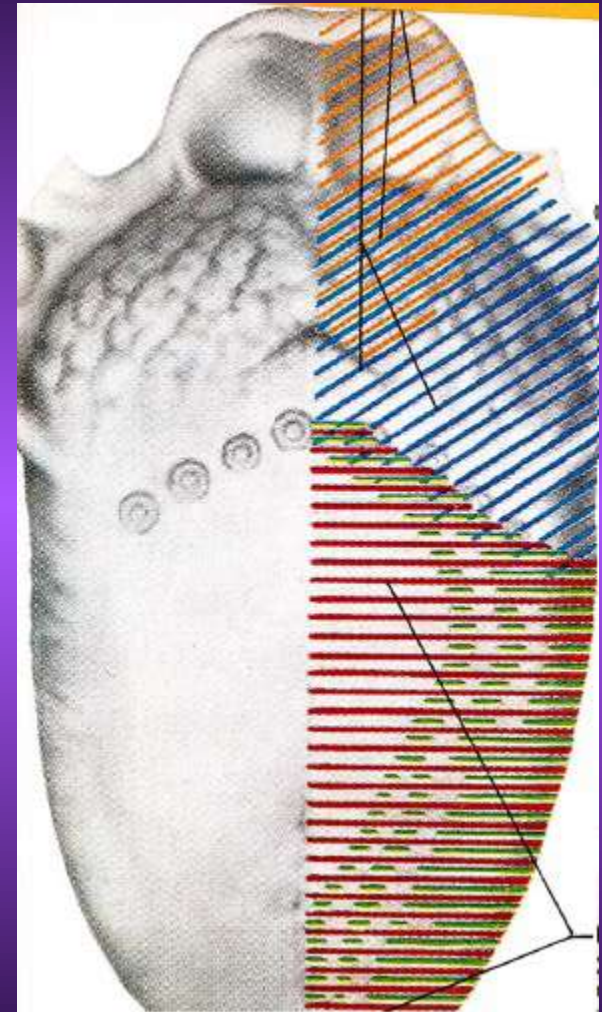
Specific for decreased sleep efficiency 71%

Specific for abnormal AHI 70%

Specific for O<sub>2</sub> desaturation of >4%, 86%



Hypoglossal / ventral



# Oropharyngeal Observations

Tongue position classification/ Freidmans

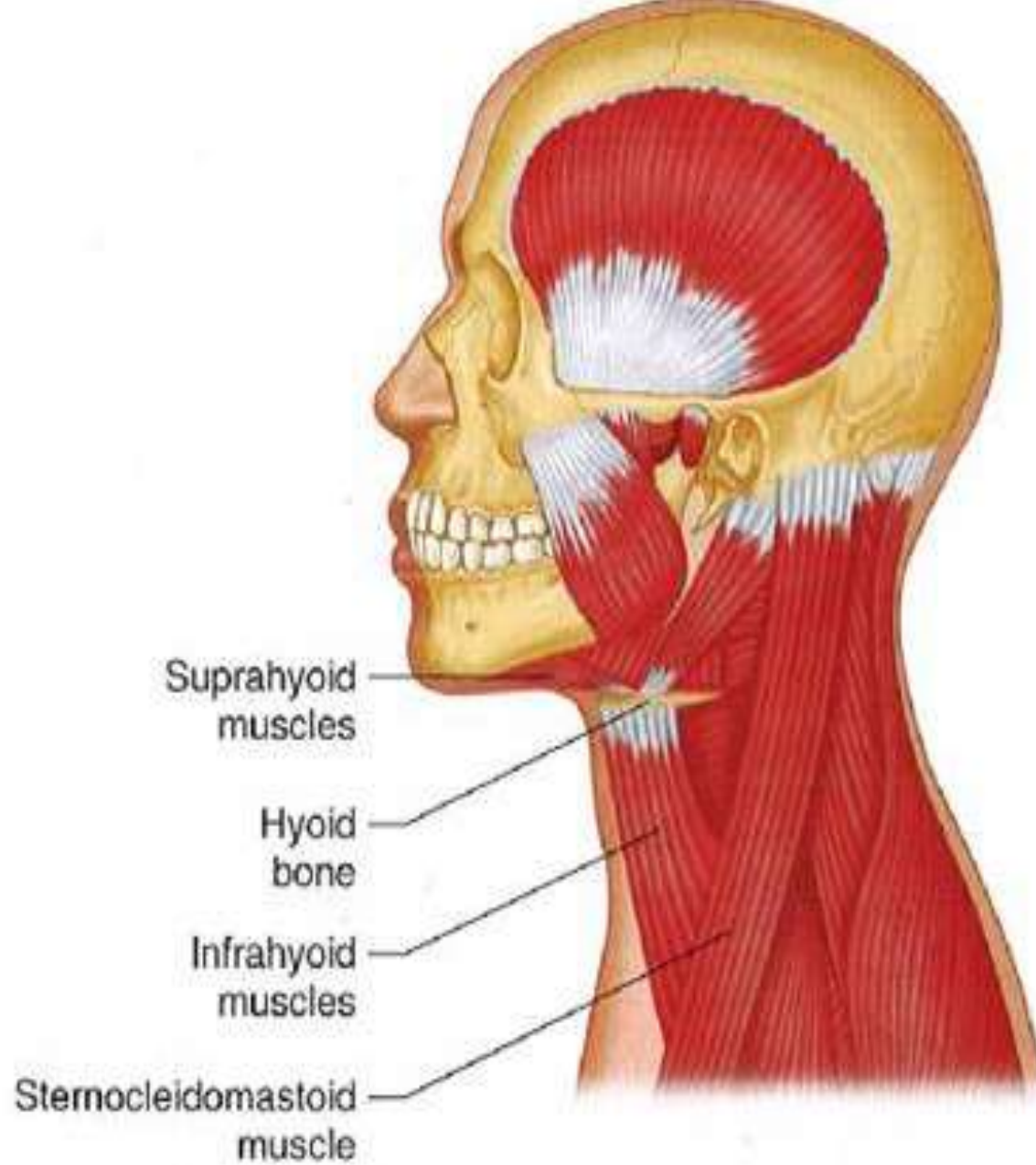
Soft palate classification, Mallampati

Uvula, elongated, enlarged

Tonsils, classification, 0 – 4+

Tongue posture, upon opening, back/down

- full dentures ?



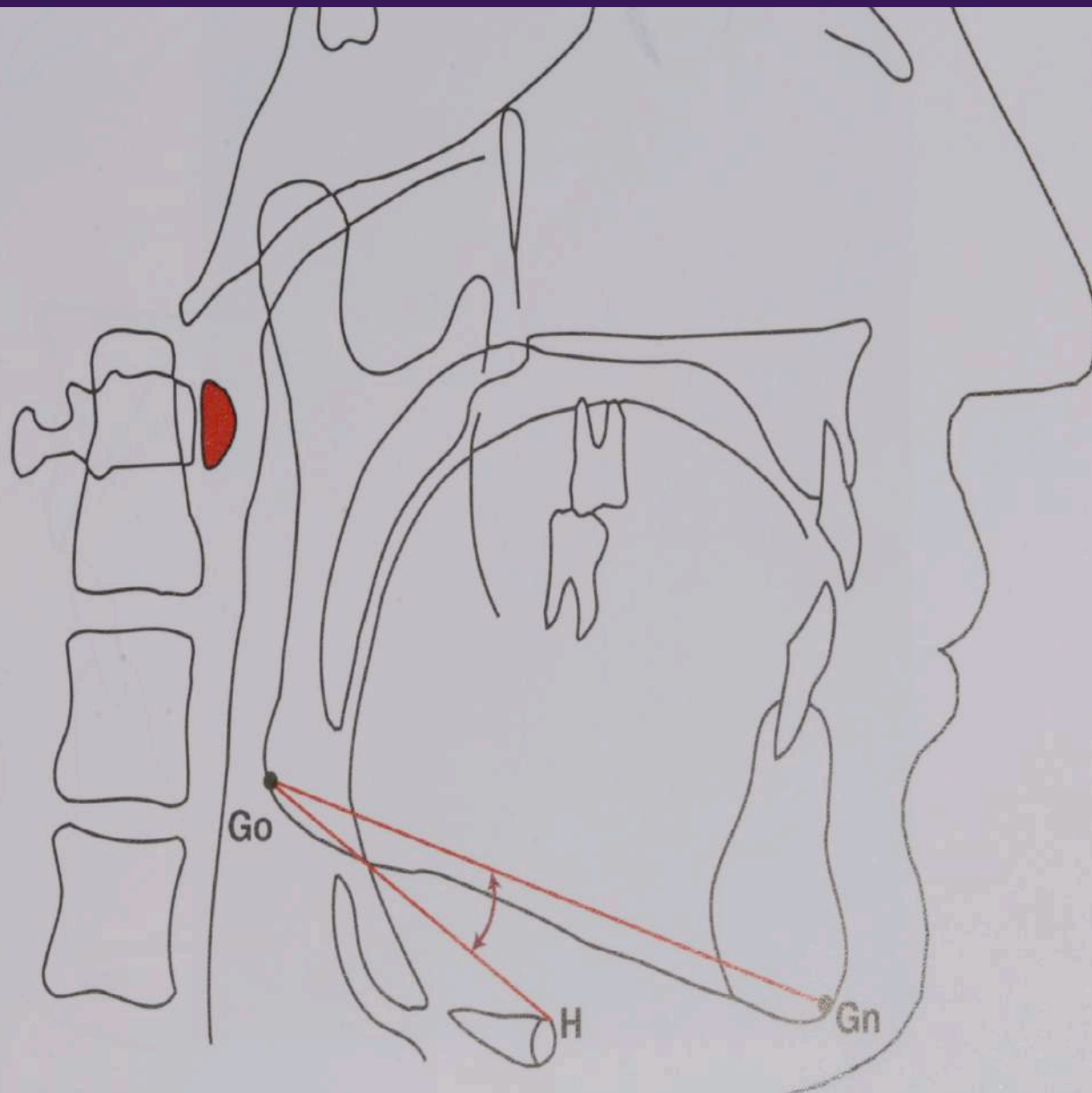


# Posture

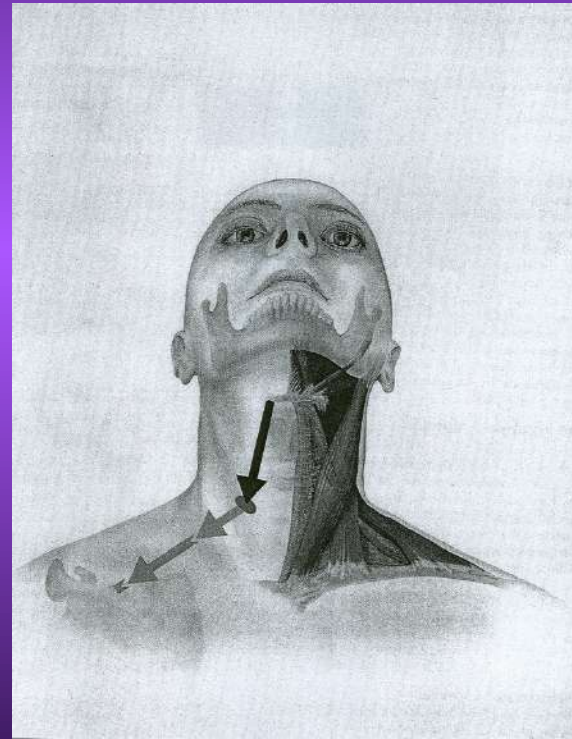
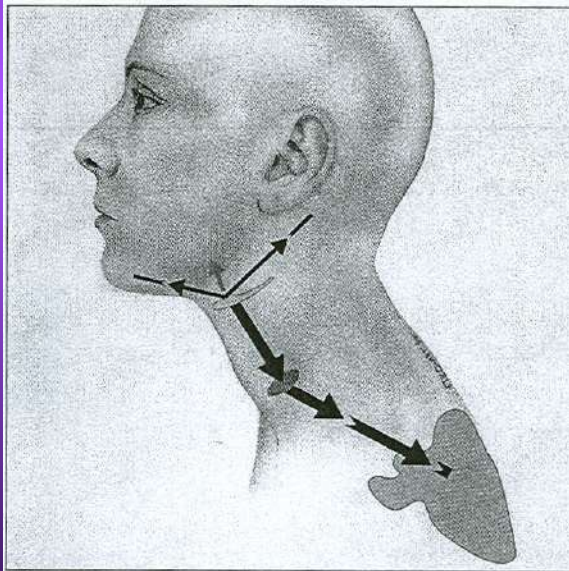
Forward head posture/ airway encroachment

Loss of lordic curve, effect on C 1,2,3

Limited neck ROM



# Omohyoid /// Infrahyoid



WHY IS IT IMPORTANT TO BE  
KNOWLEDGEABLE OF AIRWAY  
ANATOMY



BASIC CONSIDERATIONS OF NOSE  
BREATHING VERSUS MOUTH  
BREATHING

# What,s the Big deal ?

## Nose vs Mouth Breathing

Babies are born obligate nose breathers,  
which can change to mouth breathers with  
dire effects:

Dryness of the oral and pharyngeal tissues  
leading to inflamed tonsils, tonsil stones,  
swollen tongue, halitosis, gingivitis, caries.

# Respiration Factoids

Normal nasal breathing, 10-12 /minute

Mouth breathing 12-20 / minute

Breathing brings O<sub>2</sub> to cell , CO<sub>2</sub> released

CO<sub>2</sub> needed to release O<sub>2</sub> from hemoglobin

Triggers breathing, maintains blood pH

Prevents smooth muscle spasms

All the above reduced in mouth breathers

# Nasal Airway Functions

Humidifies the air to a 80% level

Warms the air

Filters the air

Sense of smell

Oxygen absorption by the lungs is greatly enhanced by by these effects



# Nose – Basic Facts

Humidifies inspired air ~80 %

Warms inspired air to ~90 degrees

Filters the air

Nitric Oxide, as a gas, is released by the paranasal sinuses. Vasodilator which increases uptake of O<sub>2</sub> by the blood. (mouth breathers)

# Tongue, Palate, Nasal Breathing

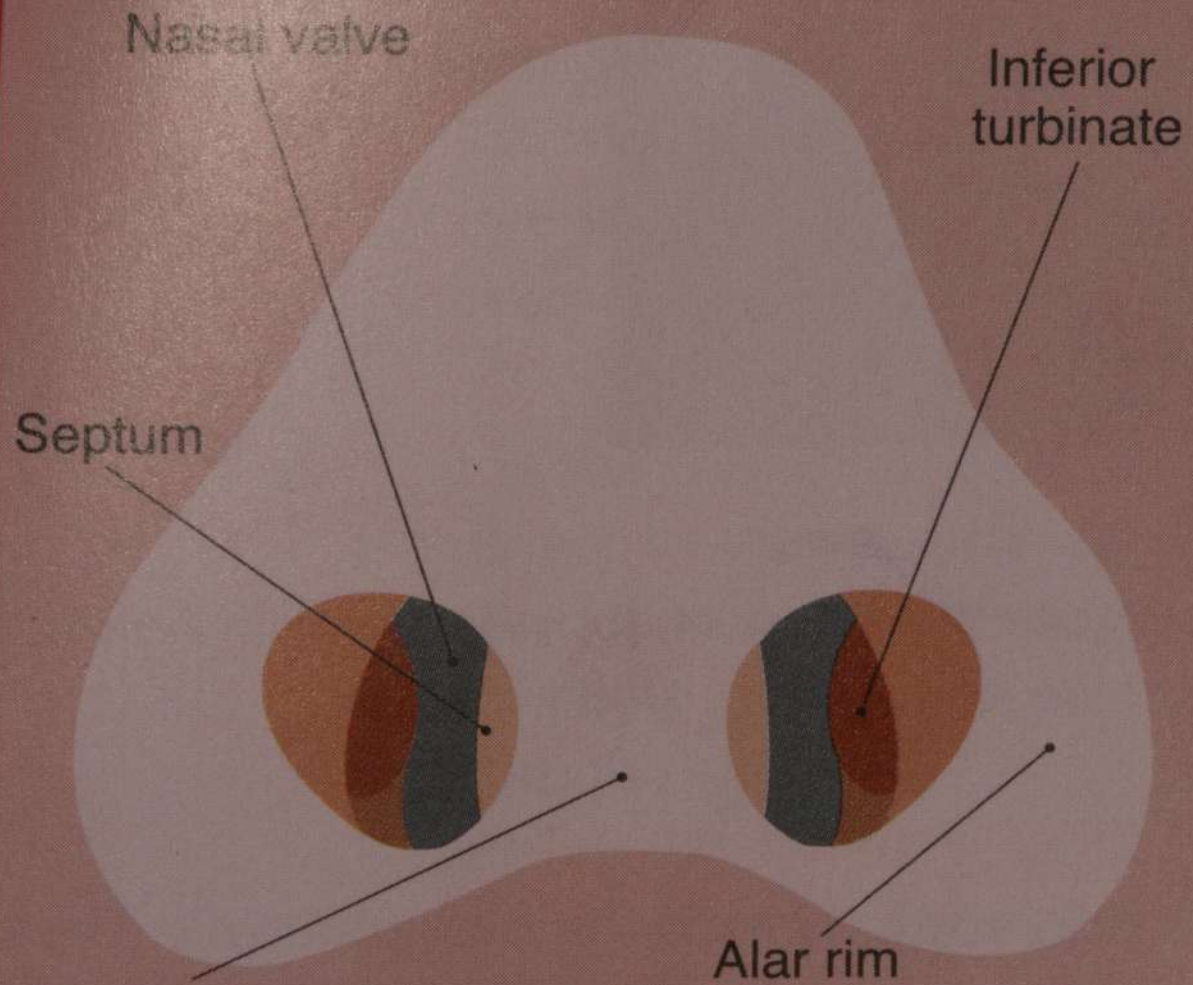
Nasal breathing:

- tongue against palate
- passive pressure stimulates stem cells in palatal suture to normal palatal growth
- healthy arch form counters the inward pressure of the buccinators

# Tongue , Palate, Mouth Breathers

Mouth breathers:

- tongue is down and forward
- lacks passive pressure to stimulate stem cells for active palatal growth
- buccinators can now push the dentition inward resulting in a narrow palate and Androidial face appearance





# Normal Airway Anatomy

Nose is divided into left/right chambers by the septum

Alar rims surround the nasal opening

Columella joins the rims at the center

Turbinates, lateral wall across from the septum

Nasal valve is the opening between the septum and the turbinates

# Nasal Valve

Nasal valve is the opening between the septum and the turbinates

Size greatly effects the air flow

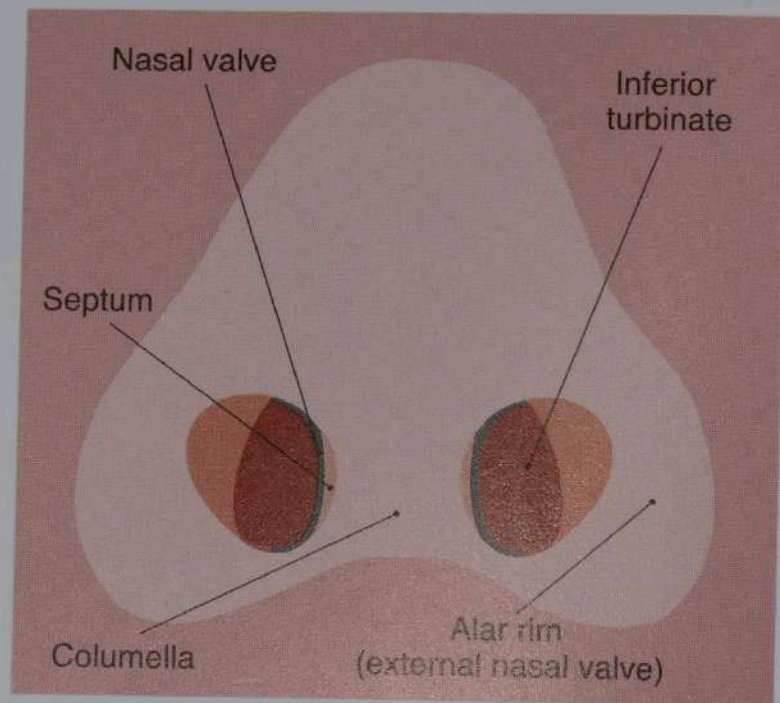
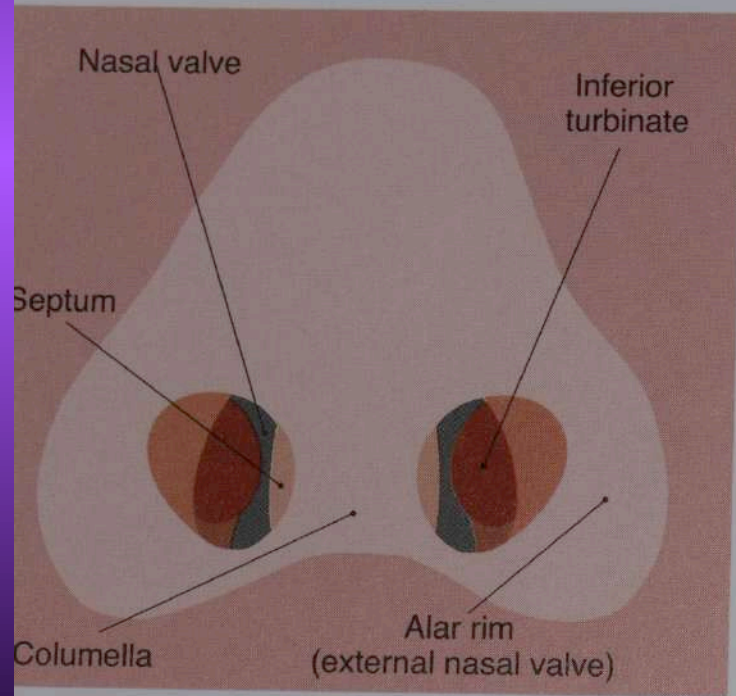
NV size is greatly effected by allergies, colds, deviated septum, and pathology (polyps)

Breath Rite Strips

# Poiseuille's Law

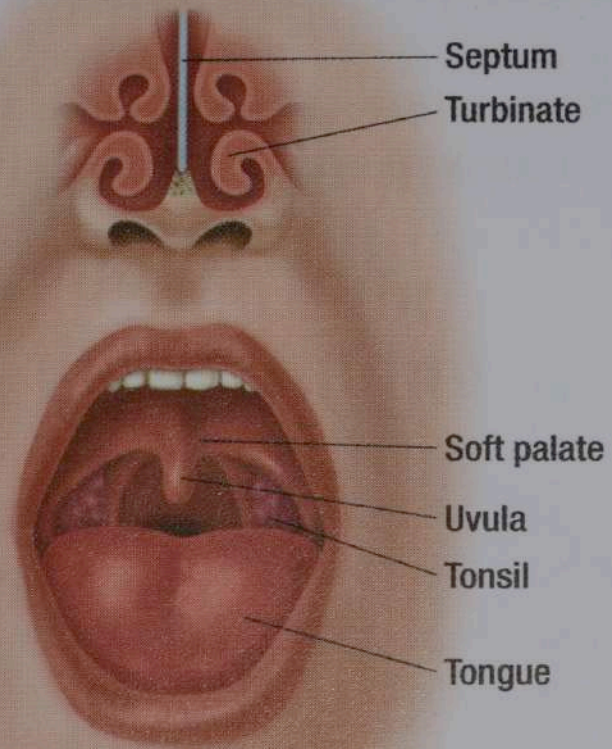
The inspiratory pressure required to draw air through the nose is impacted by the fourth power of the radius .

Small changes in the area of the nasal valve have a significant effect on air flow

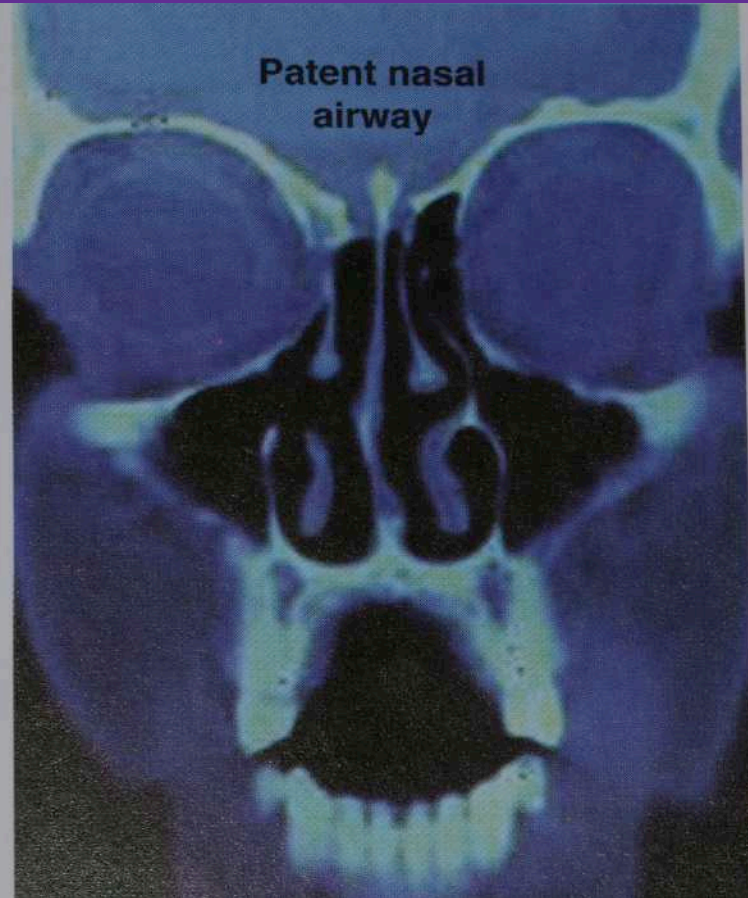


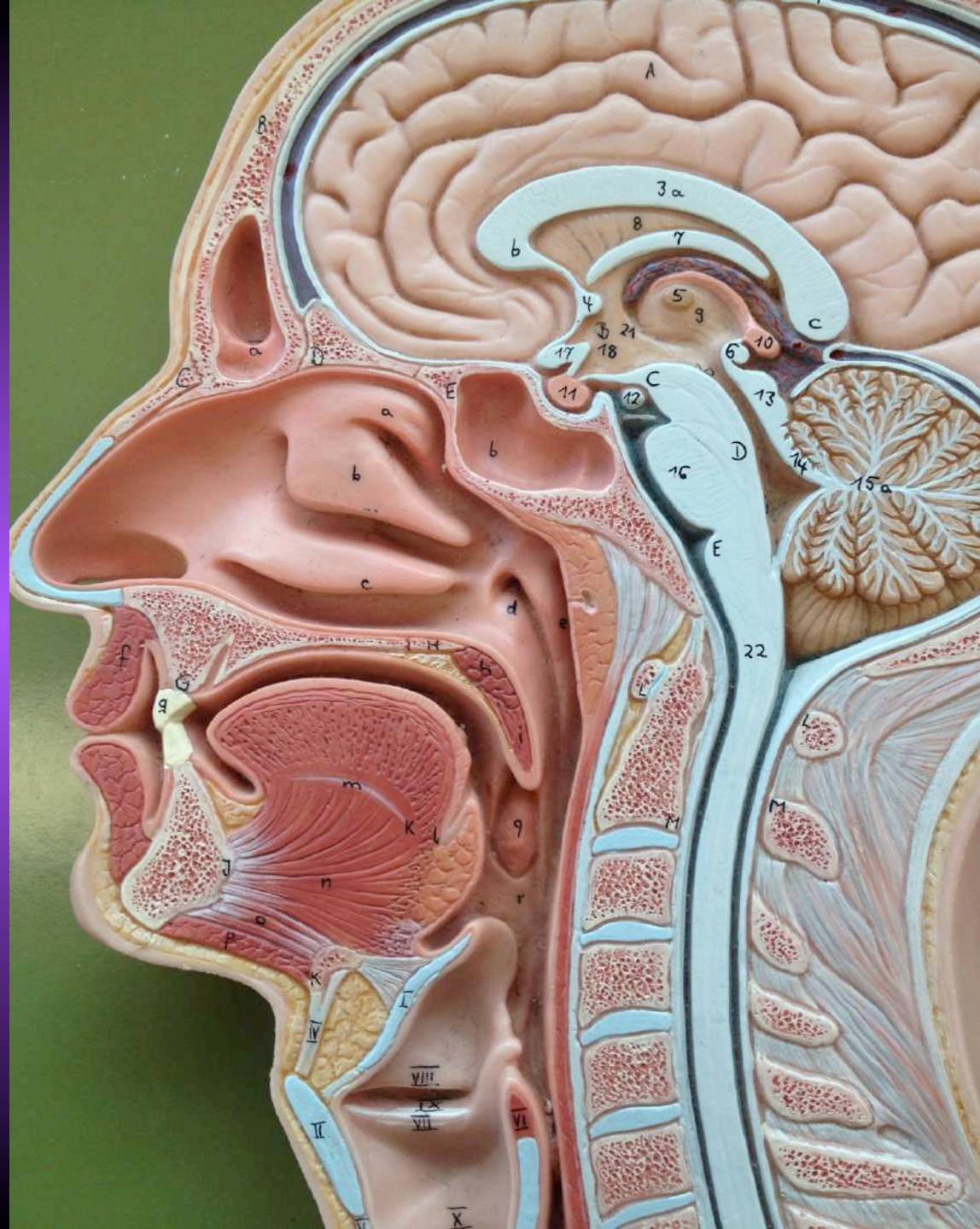


Front view of nose and mouth

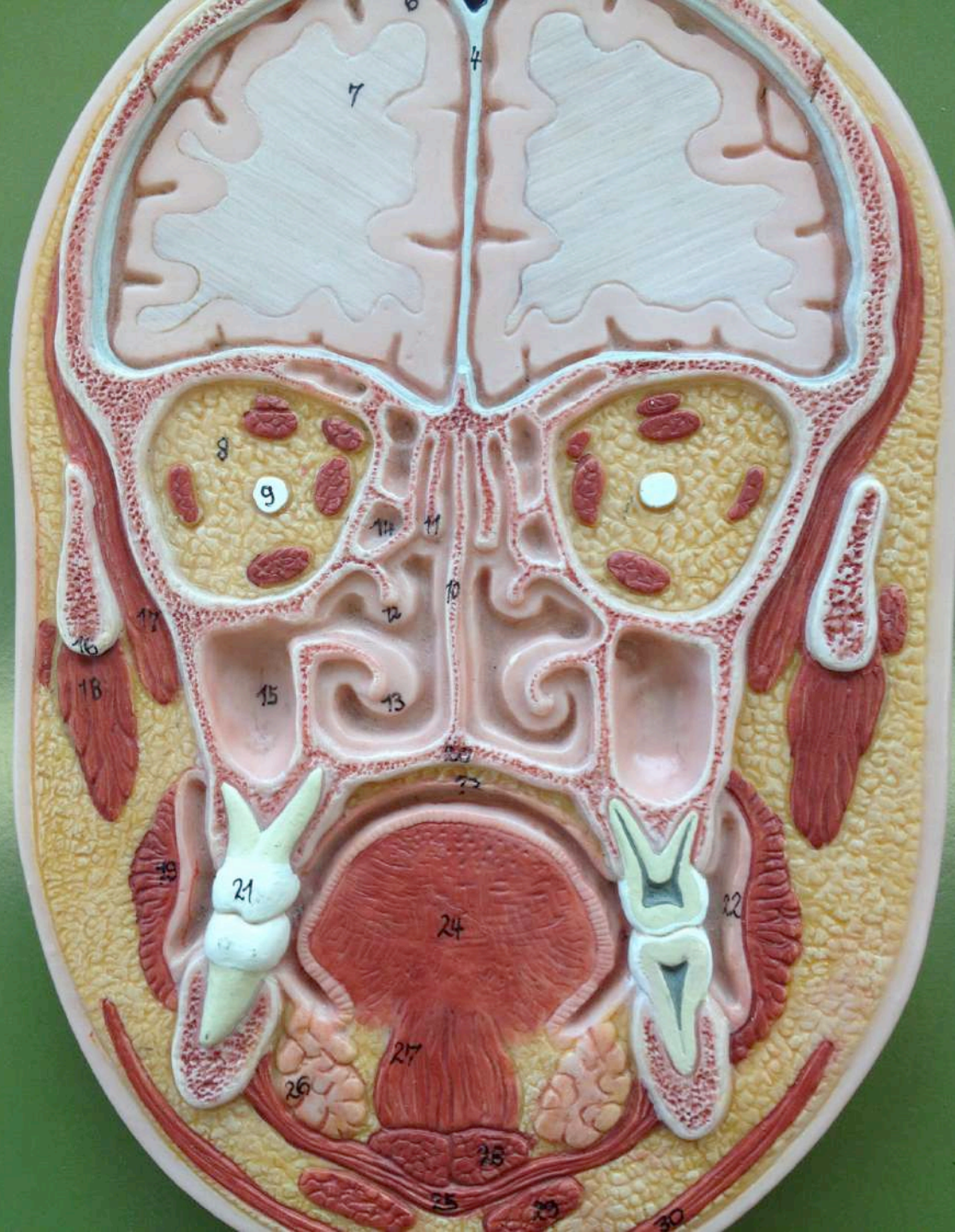


Patent nasal airway

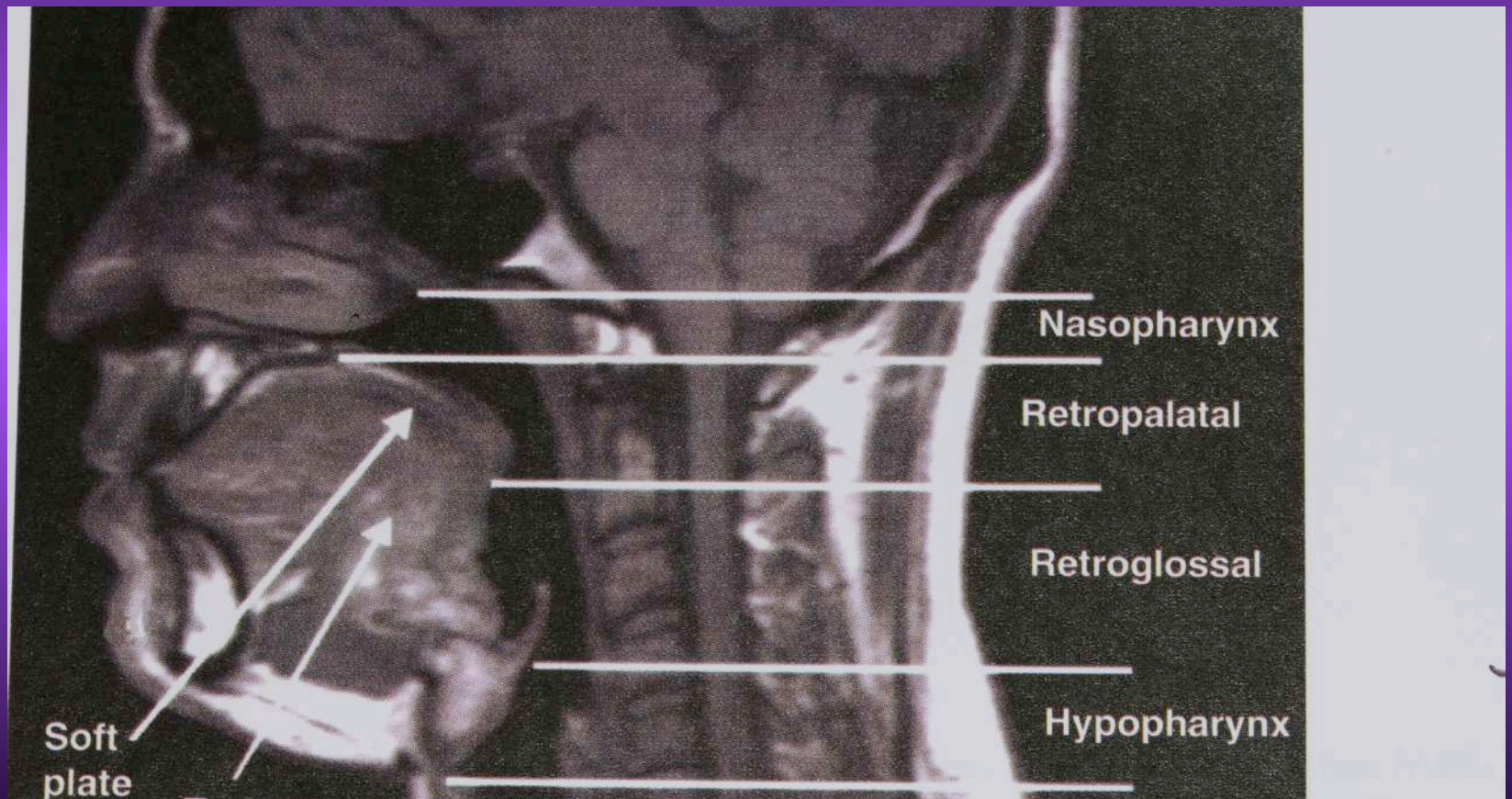


















An increase in airway obstruction yields an increase in inspiratory pressure which can collapse the airway and increase the risk of Obstructive Sleep Apnea

# Relationship of the Nose and Sleep Disordered Breathing SDB

SDB can worsen by nasal obstruction

Nasal Occlusion decreases nasal patency and  
increases intra -thoracic pressure

any cause of nasal congestion predisposes  
SDB

Oral breathing in children leads to facial  
structure abnormalities

# Relationship of Nasal Obstruction and OSA

Nasal Airway Resistance



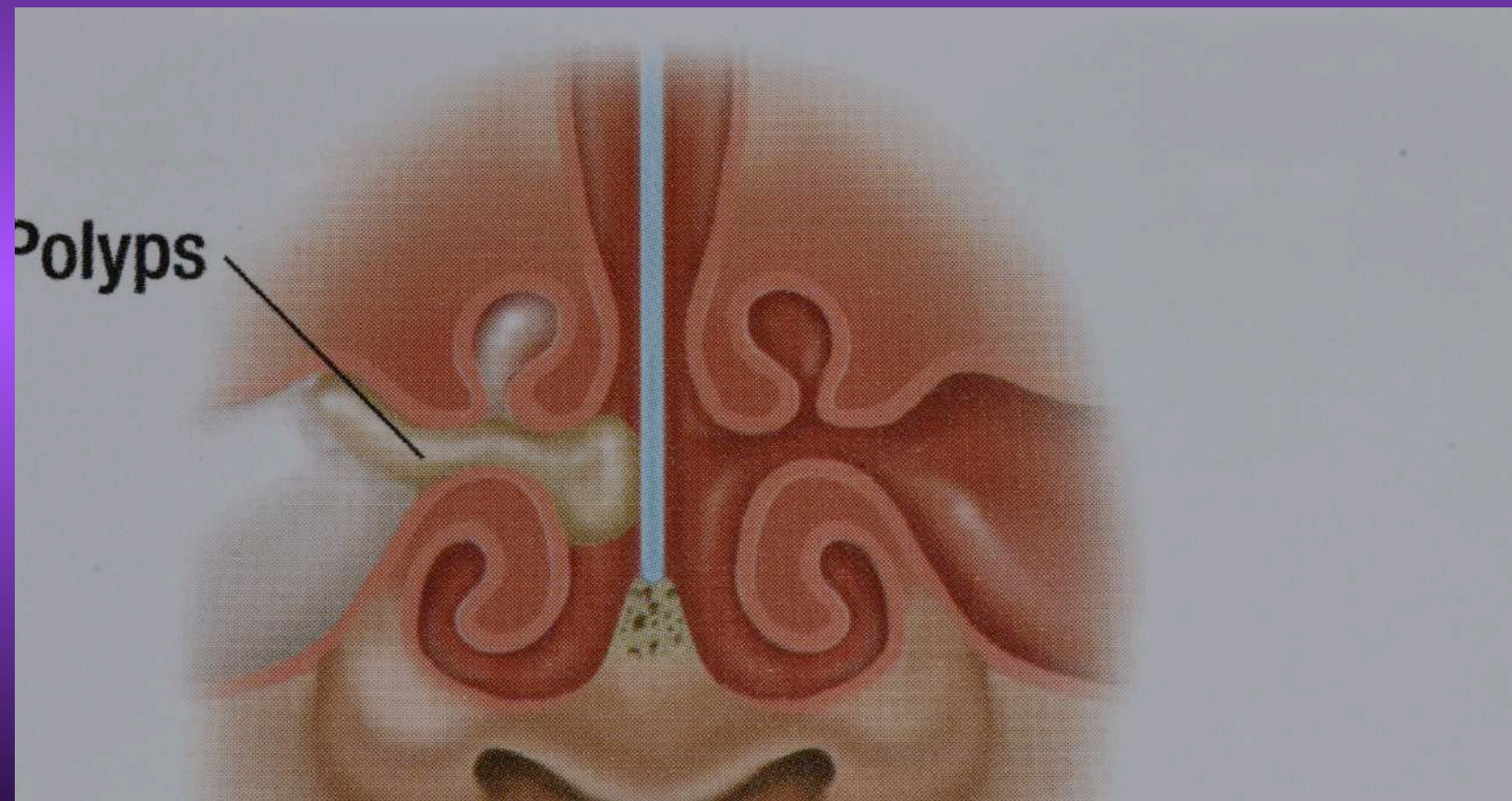
Increased Respiratory Pressure



Increased Intra-Thoracic Pressure



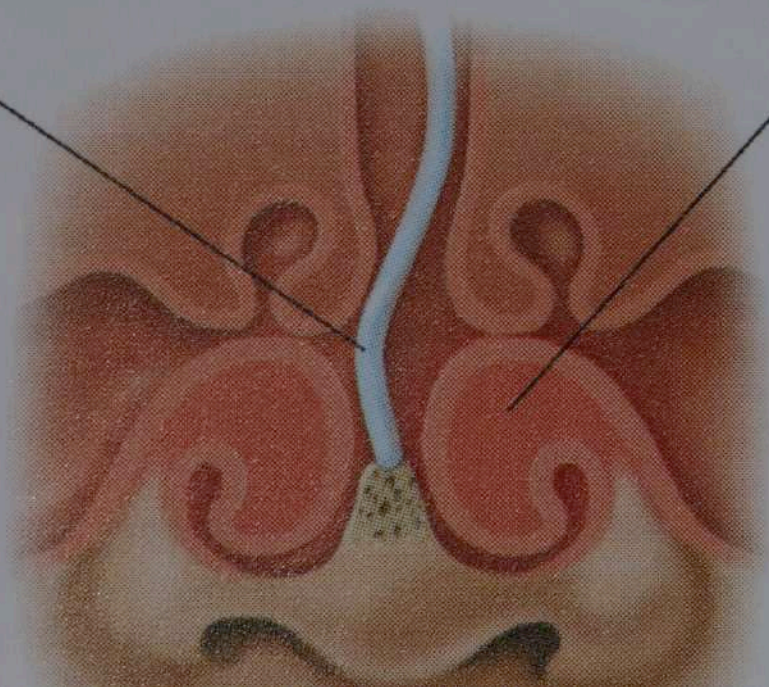
Airway Collapse (Snoring & Sleep Apnea)

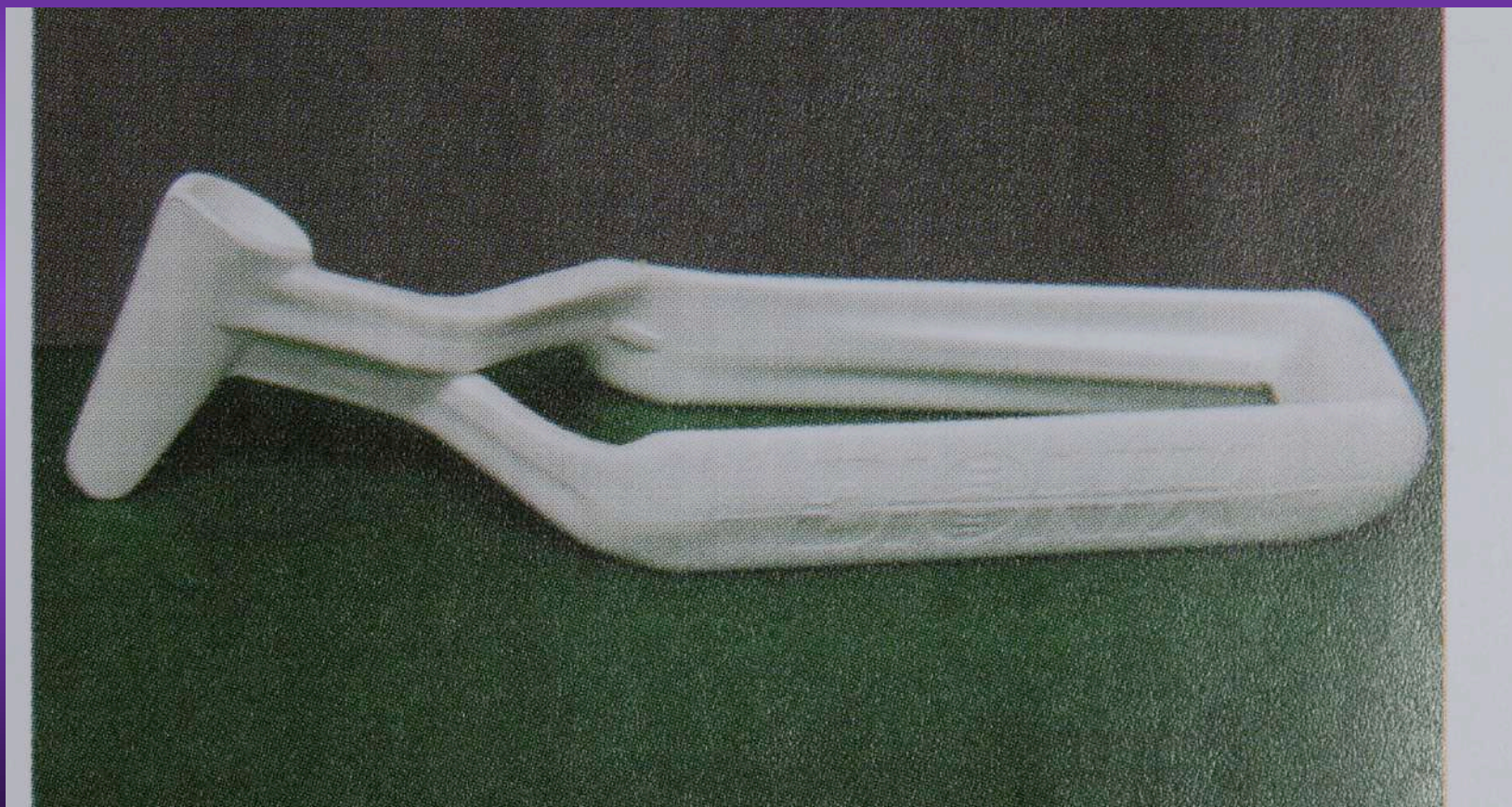




**Deviated  
septum**

**Swollen  
turbinate**









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